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# WORLD COTTON PRODUCTION AND USE: Projections for 1985 and 1990

Keith J. Collins  
Robert B. Evans  
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#### ABSTRACT

World cotton consumption and production could reach between 69.9 and 75.6 million bales by 1985, and 75.2 and 83.6 million bales by 1990 under two alternative assumptions about world economic growth. A reduced rate of decline in cotton's share of the world fiber market is expected because of increasing affluence in developing countries where cotton represents a high proportion of total fiber consumed, a stabilization of cotton's share in developed nations, worldwide population increases, and expected increases in manmade fiber prices. U.S. cotton production could total 10 to 13 million bales by 1990, depending on world income growth, while exports could range from 3.6 to 6.3 million bales.

Keywords: Commodity projections, International trade, Cotton, Manmade fiber, Textiles.



## PREFACE

At the request of Dale E. Hathaway, Assistant Secretary of Agriculture for International Affairs and Commodity Programs, the Economics, Statistics, and Cooperatives Service (ESCS) and the Foreign Agricultural Service (FAS) cooperated in the fall of 1978 to provide an assessment of demand and supply for cotton through 1990.

In this forward look at the world cotton market and the U.S. role, several assumptions about supply and demand are examined. Total fiber and cotton demand alternatives and possible changes in the geographic distribution of cotton production are investigated. The impact of the rising cost of petroleum, as reflected in manmade fiber prices and interfiber competition, is examined. Implications are emphasized for U.S. exports and production. Each major cotton producing and consuming region is analyzed to identify existing and emerging factors that could affect future consumption and production. This study thus provides basic information, analyses, and projections that will assist persons interested in the longrun market potential for cotton.

Many persons in ESCS and FAS contributed to this research, especially John Baritelle, Marshall Godwin, Gordon Lloyd, and Joseph Stevenson.

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## SUMMARY

World cotton production and use could rebound from the depressed levels since 1974 and grow strongly again, based on a longrun analysis of production and use. The analysis, a combination of statistical trend estimation and informed judgment, projects levels of a variety of cotton market variables to 1985 and 1990 for 21 geographic regions. The projections are not forecasts; they represent estimates of future potential based on historical growth.

The projections are derived under general assumptions involving economic and noneconomic market determinants, chiefly the competitive conditions for cotton and substitute fibers. Cotton and manmade fiber are viewed as continuing to have physical properties similar to those possessed today. Although cotton has many different staple lengths and other qualities, it is viewed here as an aggregate of all qualities. Between now and 1990, especially in developed regions, cotton and manmade fiber are assumed to enter an era of mature competition where the relative price of cotton and manmade fiber will become more important in determining each fiber's market share. The price of manmade fiber is assumed to rise relative to that for an equivalent amount of cotton staple, compared with the average of their price levels during 1974-77.

Two sets of demand projections are developed. Total fiber demand depends primarily on income and population growth; thus the two demand alternatives reflect different global income growth rate assumptions. The higher demand projections use income growth rates similar to those actually experienced since the sixties, with adjustments for the growth slowdown of recent years. The lower projections use growth rates generally 25 percent less to account for the possibility of continued slow world economic growth.

Over 1976/77-1977/78, world cotton area harvested, production, and yield averaged 31.8 million hectares, 61.8 million bales, and 422 kilograms/hectare. Projections indicate these changes:

- \* World production is projected to rise to 69.9 and 75.6 million bales in 1985 under the lower and higher demand alternatives, respectively. In 1990, these levels increase to 75.2 and 83.6 million bales.
- \* World area harvested is projected to be 31.9 and 34.4 million hectares in 1985 under the two demand alternatives and 32.2 and 35.7 million hectares in 1990.
- \* World yields are projected to reach about 480 kilograms/hectare in 1985 and 510 kilograms/hectare in 1990 under either demand alternative.

The following conclusions concern cotton use and production in foreign developed regions:

- \* Little change is projected in area, production, and yield. Production projections range from 1 to 1.4 million bales, compared with the 1.1 million annual average for 1976/77-1977/78.
- \* Cotton's share of the fiber market, 37 percent in 1974, is projected to decline to 33 percent in 1985 and 32 percent in 1990 under either demand alternative.
- \* The reduced rate of decline in cotton's market share and rapidly increasing textile production in developing countries is projected to result in large increases in cotton textile imports.



The following conclusions concern cotton use and production in developing regions:

- \* From the 24.7-million-bale annual production average for 1976/77-1977/78, production is projected to rise to 29.6 and 32.7 million bales in 1985 under the lower and higher global cotton use projections. In 1990, these levels rise to 31.7 and 36.7 million bales.
- \* Cotton's share of the fiber market is projected to decline to 60 percent in 1985 and 56 percent in 1990, from 67 percent in 1974.
- \* With large projected increases in mill capacity, little change is projected in net cotton exports. However, from the 1974 level of 1.7 million bales, net cotton textile exports are projected to reach 4.5 to 4.9 million bales by 1985 under the lower and higher demand alternatives and 5.5 to 6.1 million by 1990.

The following conclusions concern cotton use and production in central plan regions (Soviet Union, People's Republic of China, East European nations, and others):

- \* Large past gains in production are expected to continue. Under either demand alternative, the 23.4-million-bale production averaged over 1976/77-1977/78 could rise to 29.2 million by 1985 and 32.4 million by 1990.
- \* Increases in per capita manmade fiber use are projected to lower cotton's share of the fiber market from 64 percent averaged in 1974 to 57 percent in 1985 and 54 percent in 1990.
- \* Depending on cotton use levels and mill expansion, cotton imports of the People's Republic of China (PRC) are projected to range from 0.2 to 1.7 million bales--a variability that will significantly affect U.S. cotton exports.

The following conclusions concern cotton use and production in the United States:

- \* In many regions of the world, the alternative demand assumptions are projected to have only small effects on production. In the United States, however, the effects on production are important. Compared with the 12.5 million bales averaged over 1976/77-1977/78, production is projected at 10.1 and 10.0 million bales in 1985 and 1990 under lower demand. Projections are 12.4 and 13.1 million bales under higher demand.
- \* Cotton's share of the fiber market, 31 percent in 1976 and 27 percent in 1977, is projected to decrease to 24 percent by 1985 and 22 percent by 1990.
- \* Under higher demand, per capita cotton use is projected to remain about the same in 1985 and 1990 as the 7.5 kilograms averaged over 1976-77. Under lower demand, it is projected to range from 6.7 to 7.1 kilograms.
- \* By altering demand, a 10-percent change in the cotton/polyester price ratio is projected to change, in the opposite direction, cotton production by 300,000 bales and exports by 150,000 bales.
- \* Cotton export projections range from 3.6 to 6.3 million bales with the demand alternatives as bounds. Exports continue to be significant in maintaining demand for U.S. cotton, despite the current lull in world use. From 1976-77 levels, net cotton textile imports are projected to rise 105 to 115 percent by 1985 and 130 to 175 percent by 1990.
- \* The regions importing the largest volumes of cotton in the world by 1990 will be the Far East and East and Western Europe, based on their deficit net cotton

trade projections. Because of political and geographic considerations, the U.S.S.R. will continue to be the primary supplier for East Europe and the United States, for the Far East. Many countries will compete for a share of the Western European market and the United States could export substantial quantities there by 1990. The Far East and Western Europe's import deficit is projected at 13.9 million cotton bales under lower and 15.3 million under higher demand assumptions in 1990.

- \* The Far East, PRC, India, and a few other developing countries will be the primary sources of U.S. cotton textile imports, based on their surplus net cotton textile trade projections. By 1990, the Far East, PRC, and India are projected to export to all countries a total of 5.4 and 5.8 million equivalent cotton bales under lower and higher demand, respectively.
- \* Rapid increases in world yields could have a significant effect on the future U.S. cotton market. Under the two demand alternatives, yields in developing countries are projected to average 344 kilograms/hectare in 1985 and 367 in 1990, compared to 286 averaged over 1976/77-1977/78. The implications of yields substantially higher than these base projections were of interest for the purposes of this report. It was thus assumed that yields in developing countries would rise to 367 kilograms/hectare in 1985 and 392 in 1990. Compared with base projections, these additional yield increases would be expected to reduce U.S. production by about 1.1 million bales and U.S. exports by about 1.2 million bales in both 1985 and 1990.

# WORLD COTTON PRODUCTION AND USE: Projections for 1985 and 1990

By Keith J. Collins, Robert B. Evans, and Robert D. Barry\*

## INTRODUCTION

A crucial issue for the world's cotton producers is whether the pause in the growth of the world cotton market since 1973/74 represents a fundamental departure from past trends that will continue or whether there will be a resumption of strong upward growth. From 1947/48 to 1973/74, world mill consumption of cotton rose from 29.4 to 62.3 million bales. <sup>1/</sup> This growth, which proceeded at a steady 2.9-percent annual average rate, has leveled off since 1973/74. For 1977/78, preliminary data set world mill consumption at 61 million bales.

The direction of future world cotton market growth is a vital consideration for the U.S. cotton industry and the U.S. Government. The basic goal of this study is to assess, through 1990, the competitive position of the United States in the world cotton economy. Production and demand determining factors are considered in each major geographic region of the world as are impacts of changes in these factors on production and use of U.S. cotton.

The 14.4-million-bale crop of 1977/78 generated about \$4 billion in gross revenues for U.S. farmers. Export sales accounted for nearly 46 percent of the utilization of the 1977/78 cotton crop and contributed over \$1.6 billion to the balance of trade. The importance of production and exports and the direct farm income and employment they are responsible for reflect only partially the significance of cotton to the U.S. economy.

Farmers are not the only beneficiaries of a healthy cotton economy. From the farm to the ultimate consumer, harvested cotton is processed or handled by gins, cotton shippers and merchants, cottonseed oil mills, warehouses, transportation facilities, textile mills, finishers, garment makers and other final producers, and retail stores. The production and sale of cotton generates income and employment in all these areas. Retail sales of cotton apparel alone amounted to \$13 billion in 1976. In addition, indirect economic activity is stimulated in the numerous industries that provide goods and services to those industries that directly handle raw cotton, its finished

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<sup>1/</sup> Throughout this study, cotton quantity is measured in raw fiber, or raw fiber equivalent, 480-pound net weight bales, unless specified otherwise. Reported crop year data are based on an August/July year.



products, and byproducts. Close to 20 million people derive all or part of their earnings in industries directly and indirectly related to cotton production and marketing.

From the farm viewpoint, the current status of cotton in the U.S. textile mill industry means the foreign market for U.S. cotton gains more importance. Under intense competition from manmade fibers and imported textiles, U.S. mill consumption of cotton began a steady descent, from 9.6 million bales in 1965/66 to 6.5 million in 1977/78. This decline has not been reflected in concomitant reductions in production.

Exports have helped to maintain domestic demand by compensating for declining mill consumption, despite the stagnation in world consumption. In fact, for 1977/78, one of the low points in domestic mill consumption in this period, exports reached 5.5 million bales. In the last 15 years, this level of exports was exceeded only by the 6.1 million bales exported in 1973/74. Based on forward sales, undelivered exports, and world demand/supply projections, exports of about 6.0 million bales are indicated for 1978/79. An important issue for U.S. cotton producers is whether exports can continue to compensate for declining mill consumption and maintain disappearance levels for U.S. cotton. This issue will be analyzed through a determination of how the foreign demand for U.S. cotton changes as the size of the world cotton economy changes.

A number of large-volume foreign producers of cotton and potentially large volume producers are planning to increase cotton production over the next decade. Foreign demand for U.S. cotton will depend on the success of these and other supply side developments. The demand for textiles continues to rise as world population and income rise. Increasing prices for durable goods and necessities such as housing, food, and energy, however, could affect the share of consumer expenditures going to textiles. Cotton will continue to face strong competition worldwide for the consumer dollar from manmade fibers as well as nontextile products.

The levels of future world demand for cotton and for U.S. exports also have significant ramifications for the financial commitment to cotton producers currently made by the U.S. Government. The Food and Agriculture Act of 1977 allows deficiency payments to be made when the market price is below the target price. The extent of deficiency payment coverage for each producer is determined by the national program acreage. This acreage is set to equate cotton production to use to ensure an adequate carryover. Clearly, Government decisions on future target prices and national program acreage levels will depend heavily on foreign production/consumption balances.

Government decisionmakers must also consider foreign production/consumption price responsiveness and international price levels when establishing the cotton loan rate. A rate above parity with international prices could lower exports and lead to large additions to Government stocks. The Emergency Agricultural Act of 1978 attempts to prevent such distortions by detailing a formula for loan rate calculation that includes consideration of a 15-week average of prices of many types of cotton in northern Europe.

Current agricultural legislation in the United States is intended to promote stabilization of the U.S. cotton market. Since the U.S. and foreign markets are linked through trade, implementing the legislation requires an understanding of the way in which the markets are linked and a forward look at the level and stability of U.S. exports. In this study, we analyze foreign cotton production and consumption region by region.



## Objectives

Major research objectives are to:

- (1) Provide projections for 1985 and 1990 for both total fiber use and cotton textile use in each region of the world, accounting for economic growth and competitive products. 2/
- (2) Provide projections for 1985 and 1990 for cotton area harvested and yield in each region of the world. These projections provide information on how market forces and national development plans could combine to alter the world's geographic distribution of cotton production in the future. Combining these data with cotton use projections, the future level of self-sufficiency in each geographic region may be determined.
- (3) Provide projections on regional cotton mill consumption for 1985 and 1990. These, when combined with cotton production and cotton use projections, allow the level of self-sufficiency in each region to be further divided into net cotton and net cotton textile trade balances. For the United States, major cotton export competitors and potential sources for U.S. cotton textile imports are identified.
- (4) Analyze the sensitivity of the projected U.S. production and use levels under (a) alternative cotton and manmade fiber prices, (b) larger than trend increases in yields in developing countries, and (c) larger than trend production in central plan regions.

## Framework for Analysis

Several resource restraints (such as limited available data) dictated the methods used to analyze the comprehensive objectives stated above. Working within these constraints resulted in a simplified, yet unique, approach. An analytical model, structured for longrun projections, was developed. Rather than undertaking extensive statistical experimentation, we estimated simple statistical relationships and combined these with expert judgement. Country and commodity information possessed by U.S. Department of Agriculture (USDA) analysts was utilized to (1) validate model projections and, if necessary, replace them with point projections, and (2) provide a priori information to incorporate into the statistical estimation. Thus, the set of projections developed is reasonably consistent with both past trends and forces expected to be important in the future. The projections are not most-likely scenario or forecasts; they are levels that, based on past performance and underlying assumptions, are potentially attainable.

In pursuing an analytical approach, we had to make general and specific assumptions to focus the scope of the study to evaluate the market parameters that are of interest. The following major assumptions, covering all markets, are made:

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2/ Actual consumption data of fiber in processed finished product form (i.e., textiles) measured in raw fiber units are generally not available. Throughout this report, such consumption for fibers and cotton will be referred to as total fiber use and cotton textile use (or cotton use). These terms, proxies for actual end-use consumption, are defined as mill consumption plus the net textile trade balance, which is measured in equivalent raw fiber units.

- (1) There will be no major wars in the world between now and 1990.
- (2) Cotton is viewed as a homogenous commodity; no distinction is made among various staples and grades.
- (3) A synthetic noncellulosic fiber combining the best properties of both cotton and current state-of-the-art synthetics will not become widely available.
- (4) A low-cost process that permits cotton to assume all the easy-care and abrasion-resistant properties of synthetics will not become widely available.
- (5) There will be no technological advances in cotton production that permit dramatic yield increases worldwide (such as multiadversity seed variety).
- (6) Any sustained worldwide food production shortages that might occur would not result in a major shift of land from cotton production to food production.
- (7) The price of manmade fiber will increase relative to the price of an equivalent amount of cotton, compared with prices averaged over 1974-76.
- (8) Government policies on fiber consumption, production, and trade will remain unchanged from current policies unless specified otherwise in certain markets.
- (9) Cotton and manmade fiber will compete in a mature market between now and 1990, especially in developed regions. This means the relative price of cotton and manmade fiber will become more important in determining the market share of each fiber.

The analytical framework used for projection, from a single region's viewpoint, is presented in figure 1. The assumed longrun condition for equilibrium in the world cotton economy is that world cotton textile use equals world cotton mill consumption which equals world cotton production. In any single year, this equality would hold only approximately because of changing stock levels. In the long run, then, cotton and cotton textile stocks are assumed not to change from their previous year's level for each region; hence, for the world as a whole. The use of the global equilibrium condition results in a consistent set of projections; the sums of all use and production projections are equal and the sums of imports and exports for both cotton and cotton textiles are equal.

The projection sequence begins with the projection of total fiber use. Regional income and population projections applied to an estimated relation, which specifies that total fiber use depends on these variables, are used to determine the future regional total fiber use level. Cotton textile use in each region is assumed to depend on total fiber use, the ratio of cotton to manmade raw fiber prices, and other factors determining cotton's share of fiber consumption. With total fiber use determined and manmade fiber price assumed, regional cotton use equations may be aggregated to form a world cotton use equation expressed as a function of cotton price.

Projections are developed for two levels of economic growth, alternatives I and II. Alternative I projections assume income growth rates based on the rates actually experienced since the early sixties. They are adjusted downward slightly because of the slowdown in economic growth experienced in the seventies. To reflect the possibility of continued slow global economic growth through 1990, we based alternative II projections on income growth rates generally about 25 percent below those used in alternative I. Changing assumptions on income growth alters total fiber use projections, hence, cotton use projections. Alternative II's projections could be

# PROJECTION SEQUENCE FOR DETERMINING COTTON PRODUCTION, USE, AND TRADE FOR A SINGLE REGION

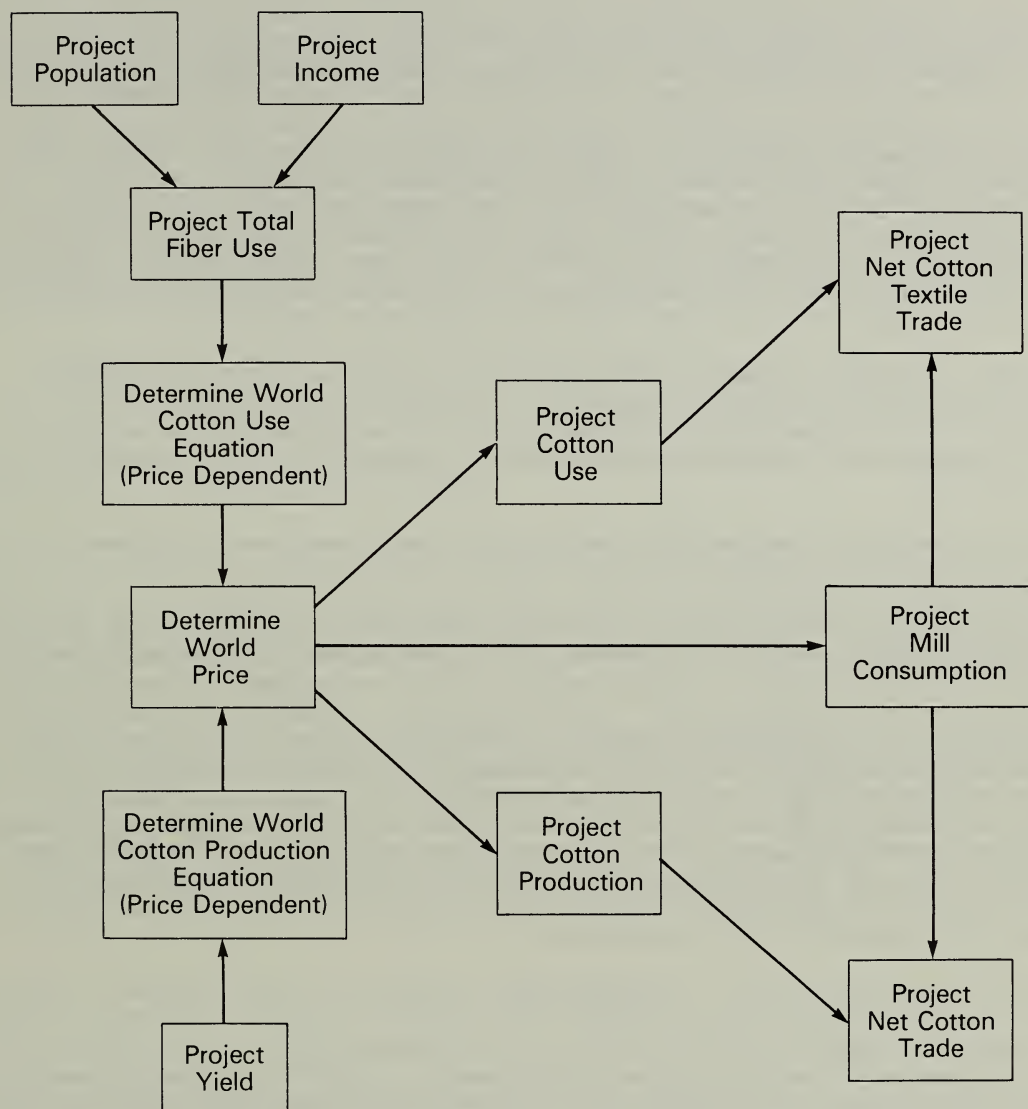


Figure 1



obtained using the total fiber use projections of alternative I, with the assumption of lower fiber market shares for cotton than those assumed in alternative I.

Different cotton use projections may also be obtained by using alternative cotton-to-manmade fiber price ratios. The representative ratio used in this study, the Liverpool A cotton price index to the U.S. polyester price, was taken to be 1.15:1. During 1974-76, a period of substantial financial losses in the manmade fiber industry, this ratio averaged 1.35:1. The assumption of a ratio for 1985 and 1990 lower than that recently experienced is based on the expectation that manmade fiber prices will cover production costs and that rising costs for oil, intermediate chemicals, energy, and plant construction and operation, will result in larger increases in manmade fiber than cotton prices. The effects on the United States of alternative ratios are examined in the section on the U.S. cotton market. In most regions, the use of a lower cotton-to-polyester price ratio strengthens cotton's fiber market share and improves the prospect for expanding cotton demand.

For supply, regional yields are first projected. Regional acreage response equations, which specify acreage harvested as a function of cotton price, are multiplied by yield to obtain production equations. When aggregated across all regions, an equation for world cotton production, expressed as a function of cotton price, is obtained.

A world cotton price, derived by equating world cotton use and production, is used to project regional use and production.

The equilibration of cotton use in processed form and production in raw fiber form to balance markets means end-use consumption is the fundamental determinant of the size of the market for cotton. In other studies, mill consumption has been used as the starting point on the demand side. Recognizing mill consumption as simultaneously creating a supply of textiles and a demand for raw fiber and starting with end use rather than mill consumption has several advantages. It permits provision of information on manmade fiber use and cotton textile trade. Most importantly, it recognizes the theoretically sound belief that, in the long run, consumers ultimately decide, through their purchasing patterns, what quantities and types of fibers the mills process. This is a significant distinction for projecting in the long run, because the longrun determinants of total fiber use are fewer in number and more identifiable than those for mill consumption.

Unlike many previous studies, regional mill consumption is not assumed to depend directly on competing fiber prices although these prices are used to determine cotton textile demand. The specification used for mill consumption is a consequence of the length of the projection period. Since mill capacity is mobile and its geographic distribution has changed dramatically over the last two decades, no simple structural specification could be expected to hold through 1990. Alternative investment opportunities within a region, relative wage rates across regions, economic growth, and government policies toward textile production and trade all help determine a region's level of mill consumption. Both mill consumption and trade balances for cotton are projected based on past trends and judgment.

## OVERVIEW OF WORLD COTTON PROJECTIONS

Cotton has historically been the single most important textile fiber, because of the characteristics it imparts to textiles, and its potential for low-cost production in much of the world. Of the textile fibers that can be used for apparel, cotton has long had 50 percent of the world market or better. In some of the most populated regions of the world, such as India and the People's Republic of China (PRC), cotton

continues to represent close to 90 percent of total fiber consumed. These consumption levels have encouraged the construction of mill capacity and processing firms to the point where well over 100 countries manufacture cotton textile products. At the farm level, at least 35 countries annually produce 100,000 or more bales of cotton. The gross farm value alone of the 1976 world crop totaled about \$22 billion, which contributed significantly to income, employment, and the balance of trade in the world's cotton producing countries.

This section examines past trends and projected levels of total textile use, cotton textile use, cotton mill consumption and production, and trade for aggregate geographic regions. The four aggregate regions represent the developed, developing, and central plan countries, and the world as a whole. Aggregation based on economic rather than other criteria, such as geographic, is used because of the textile market similarities of the countries included in each region. (See app. table 1 for the countries included in each region.)

The developed countries may be generally characterized as producing little cotton (except for the United States), having a low fiber market share for cotton (usually below 40 percent), importing cotton and cotton textiles extensively, and having mill industries that have faced financial difficulties in the seventies because of import competition and reduced textile demand.

The developing countries possess disparate cotton production capacities. In many countries, cotton is a primary farm income generator. Yields usually are low, but many regions have considerable growth potential, and cotton often has a prominent role in government economic plans. Developing countries, in the aggregate, are cotton and cotton textile exporters with growing mill capacities. Cotton's fiber market share is usually above 45 percent.

The central plan countries constitute a natural grouping because of the pervasive government influence on cotton production and use. The U.S.S.R. and the PRC are two of the world's three largest cotton-producing countries. The large cotton importing region of East Europe, which possesses strong trade ties with the U.S.S.R., is also included. Growth in mill consumption since the early sixties has been rapid in central plan regions. Cotton's market share varies from about 36 percent in East Europe to 50 percent in the U.S.S.R. and 88 percent in the PRC.

### Fiber Use

Worldwide fiber use has enjoyed strong and consistently positive growth over the last decade (table 1 and fig. 2). During 1964-74, world fiber use grew at an annual average rate of 4 percent. Fiber use grew more slowly in developed regions, and more rapidly in both developing and central plan regions. These differences can be accounted for by much larger population growth rates and some higher income growth rates for individual countries in developing and central plan regions than in developed regions. Moreover, the high per capita fiber use level in developed regions, 17.3 kg/person in 1974, compared with 3 and 6.2 kg/person in developing and central plan regions, also helps explain the differing growth rates. The per capita use levels indicate the relative strengths of incentives for each region's consumers to acquire more textile products. These levels also reflect the extent and variety of nontextile products that consumers in each region could reasonably expect to purchase.

For all regions, the rate of growth of total fiber use through 1990 is projected to decline from past growth rates. Both the lower and higher fiber use growth projections from 1974 through 1990 show annual average growth rates decreasing the most in central plan regions, somewhat less for developed regions, and very little for developing regions. These declines in projected fiber use growth rates result from

Table 1--World: Total fiber and cotton textile use to 1985 and 1990 1/

Region <u>2/</u>	:Total fiber:		:Per capita:		:Per capita:	
	: use	: fiber	: use	: use	: cotton	: Cotton's
						share
	Million	Kilograms	Million	Kilograms		Percent
	bales		bales			
Developed:						
Actual	57.86	17.3	19.97	6.0		34.5
1985 Alt. I	78.43	21.3	22.97	6.3		29.3
1985 Alt. II	74.13	20.2	21.78	5.9		29.4
1990 Alt. I	88.77	23.2	24.67	6.4		27.8
1990 Alt. II	81.93	21.4	22.80	6.0		27.8
Developing:						
Actual	26.37	3.0	17.65	2.0		66.9
1985 Alt. I	40.10	3.4	23.89	2.1		59.6
1985 Alt. II	36.35	3.1	21.64	1.9		59.5
1990 Alt. I	49.46	3.7	27.56	2.1		55.7
1990 Alt. II	42.99	3.2	24.20	1.8		56.3
Central Plan:						
Actual	36.23	6.2	23.10	3.9		63.8
1985 Alt. I	50.62	7.4	28.74	4.2		56.8
1985 Alt. II	46.36	6.8	26.52	3.9		57.2
1990 Alt. I	57.67	8.0	31.33	4.3		54.3
1990 Alt. II	51.90	7.2	28.20	3.9		54.3
World:						
Actual	120.46	6.7	60.71	3.4		50.4
1985 Alt. I	169.15	7.6	75.60	3.4		44.7
1985 Alt. II	156.83	7.1	69.94	3.2		44.6
1990 Alt. I	195.90	8.0	83.56	3.4		42.7
1990 Alt. II	176.82	7.3	75.20	3.1		42.5

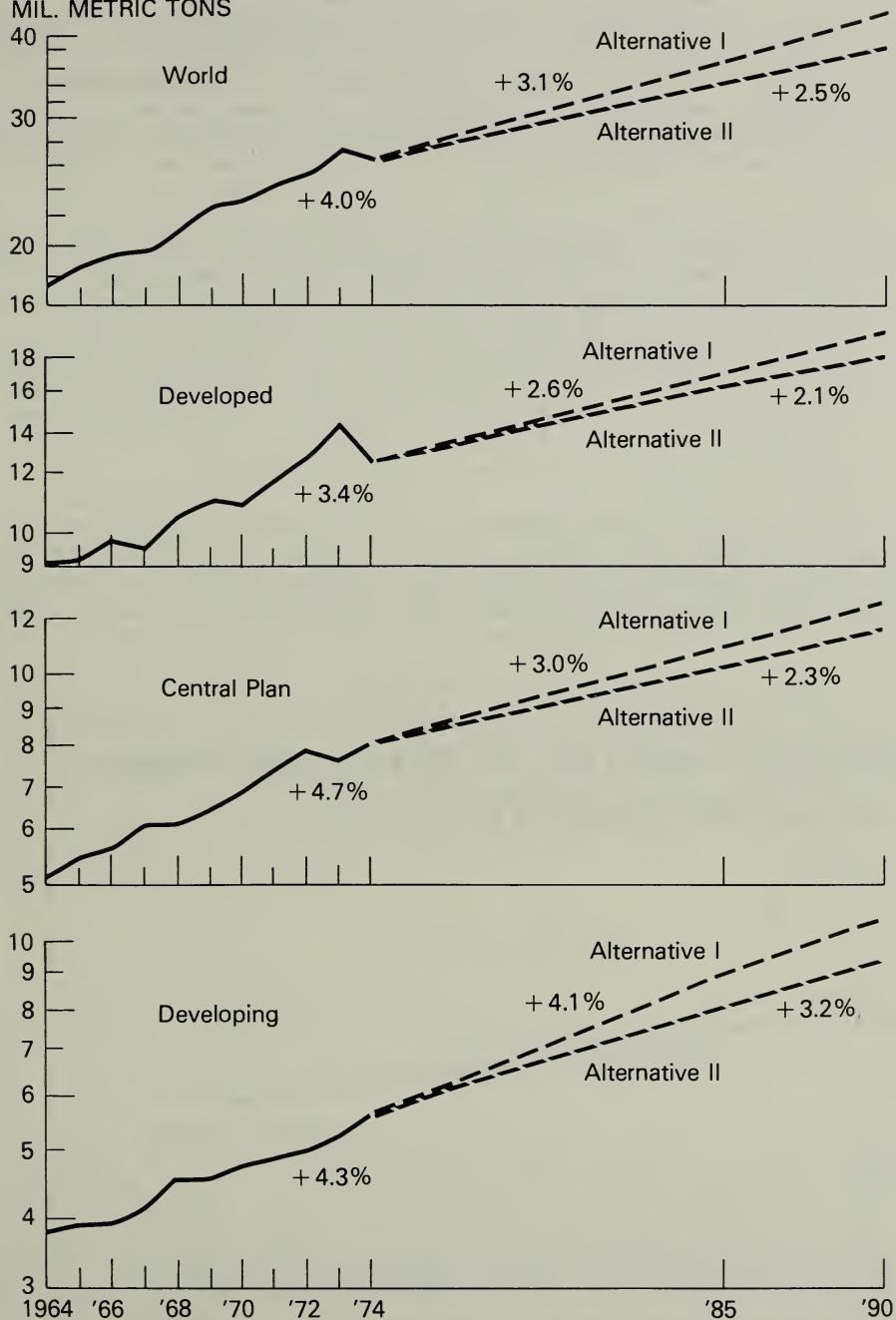
1/ The cotton-to-polyester price ratio is assumed to be 1.15:1. Totals may not add due to rounding. Note that total fiber use is given in equivalent cotton bales for comparison purposes. The conversion factor between bales and the usual metric ton measure for total fiber use in raw fiber equivalent is 1 metric ton=4.593 bales.

2/ Actual data for all regions are for the 1974 calendar year. This is the last year for which end-use consumption data are available.



# **WORLD FIBER USE: PROJECTED ANNUAL AVERAGE GROWTH RATES<sup>Δ</sup>**

MIL. METRIC TONS



<sup>Δ</sup>See footnote end of Figure 5.

USDA

NEG. ESCS 3120-78 (9)

Figure 2

slightly lower income and population growth projections than those actually experienced over the sixties and early seventies.

Both the per capita and absolute levels of total fiber use are projected to increase over 1974 levels in all regions, despite declining growth rates. In fact, examination of the absolute projected levels reveals an encouraging view of the total world fiber market. The average annual gain in total fiber use during 1964-74 was 3.9-million-equivalent bales of cotton. Through 1990, the lower demand projections call for an average annual world gain of 3.5 million bales, while the higher demand projections set the gain at 4.7 million bales.

Across the regions of the world, the share of total fiber use occupied by cotton textiles has behaved erratically. In some regions, such as Egypt and Sudan, it has risen. In others, such as Turkey, it has declined at a slow, steady rate. In the United States and many other developed regions, cotton's share fell slowly at first, accelerated during the sixties, and returned to a very slow decline in the seventies. For the world as a whole, the decline in cotton's share was steady from 1960 to 1971, falling from 68 to 51 percent of the fiber market (fig. 3). Since then, it has remained close to 50 percent. Until the early sixties, manmade cellulosic fibers, rayon and acetate, were cotton's main competition. Since then, primarily noncellulosic fibers, especially polyester, have been cotton's competitor.

Reasons for diverse regional experiences range from presence or lack of large manmade fiber plants, availability of homegrown cotton, and social custom (such as the affinity for wall-to-wall carpeting manifested in the United States) to government policies promoting or discouraging cotton use. This impetus behind cotton's decline has mainly been provided by consumer preference for easy-care and abrasion-resistant

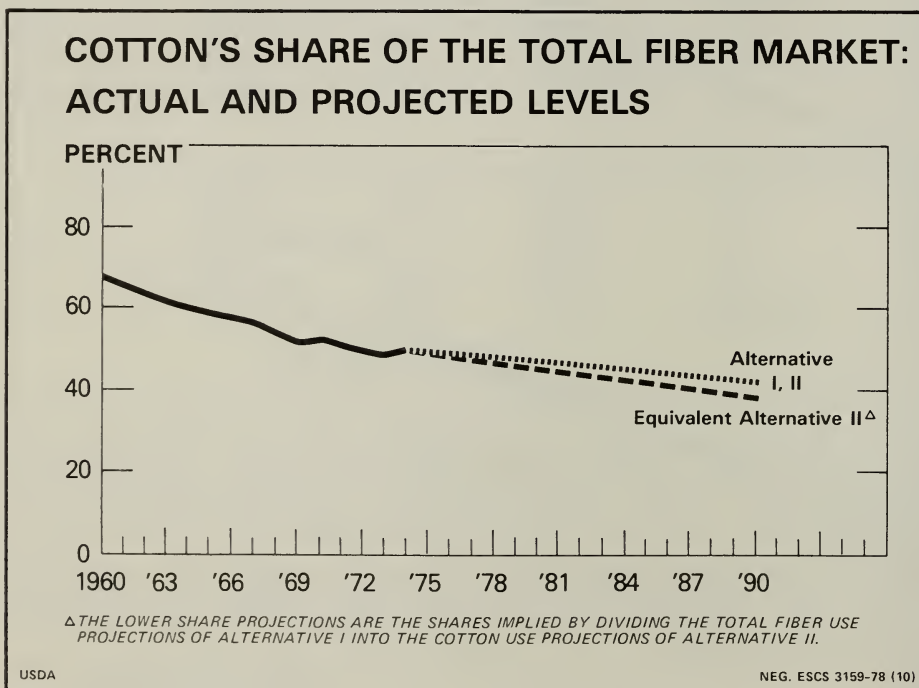


Figure 3



fabrics that could be made from a fiber that is price competitive with cotton. A continuation of this impetus with an accompanying worldwide decline in cotton's share is projected through 1990.

The erosion of cotton's share of the world fiber market is projected to proceed at a slightly declining rate, from 50 percent of the market in 1974, to slightly less than 45 percent in 1985, and less than 43 percent in 1990. The average annual rate of decline is 1.1 percent over the first 11 years falling to 0.9 percent over the last 5, compared with an annual average rate of decline of 1.5 percent experienced during 1964-74. This slowdown results from projected increased price competition between manmade fibers and cotton.

Also slowing cotton's decline are ever-increasing limitations on apparel substitution opportunities for manmade fiber in many regions whose cotton share is presently below 50 percent. Such limitations simply follow from fewer available end uses in cotton which manmade fiber could possibly capture. In addition, end-use requirements limit substitution. The projected slowdown in the decline of cotton's share means the demand-increasing influences of population and income growth will be more strongly felt as the projection period proceeds. Pressure will mount for greater cotton use and production, and for U.S. exports, as 1990 approaches.

Projections for world cotton use show a slight decline in annual average growth rates compared with the rate experienced during 1964-74 (fig. 4). This is due partly to the lower than historical income and population projections and partly to the continued loss of cotton's market share. Since cotton's market share is already lowest in developed regions, small positive growth rates are projected for cotton use compared with the recent negative historical rate.

In developing regions, future demand for cotton appears strong; growth projections bracket the past rate. The largest decline from past growth is projected for central plan regions. Although their rate of growth of cotton use was the largest of the three regions during 1964-74, their anticipated increases in manmade fiber production capacity are expected to provide strong competition for cotton over the next decade. Overall, the projections indicate that the current pause in the growth of world demand for cotton is temporary.

### Cotton Production

The increases in world cotton production over the last two decades have come almost exclusively through yield increases. Annual cotton area harvested has usually been close to the 1964-77 average of 32.2 million hectares. Yield, however, advanced from 350 kg/ha to approximately 430 kg/ha over the same period.

In table 2, world production projections, derived from aggregated regional projections, show gains in both yield and area under the higher demand alternative. Area gains reflect increased production potential in Other South America, Turkey, Sudan, Other Africa, Pakistan, and the U.S.S.R. No major area expansions are foreseen in other regions. Yield increases are projected to continue at an annual average rate of 1.3 percent, compared with the somewhat higher 1.7 percent averaged during 1964-77.

World cotton production through 1990, as with cotton use, is projected to grow at a rate close to past levels under the higher demand alternative (fig. 5). Under the lower demand alternative, the rate is projected to be two-thirds of the past rate. Over the projection period, growth in production in developed regions is projected to increase over past rates. The past rate of 1.4 percent, however, reflects much instability in U.S. production because of policies designed to reduce stocks in the sixties and some abnormally low yields. In developing regions, the past growth rate

Table 2--World: Cotton area, yield, and production to 1985 and 1990 1/

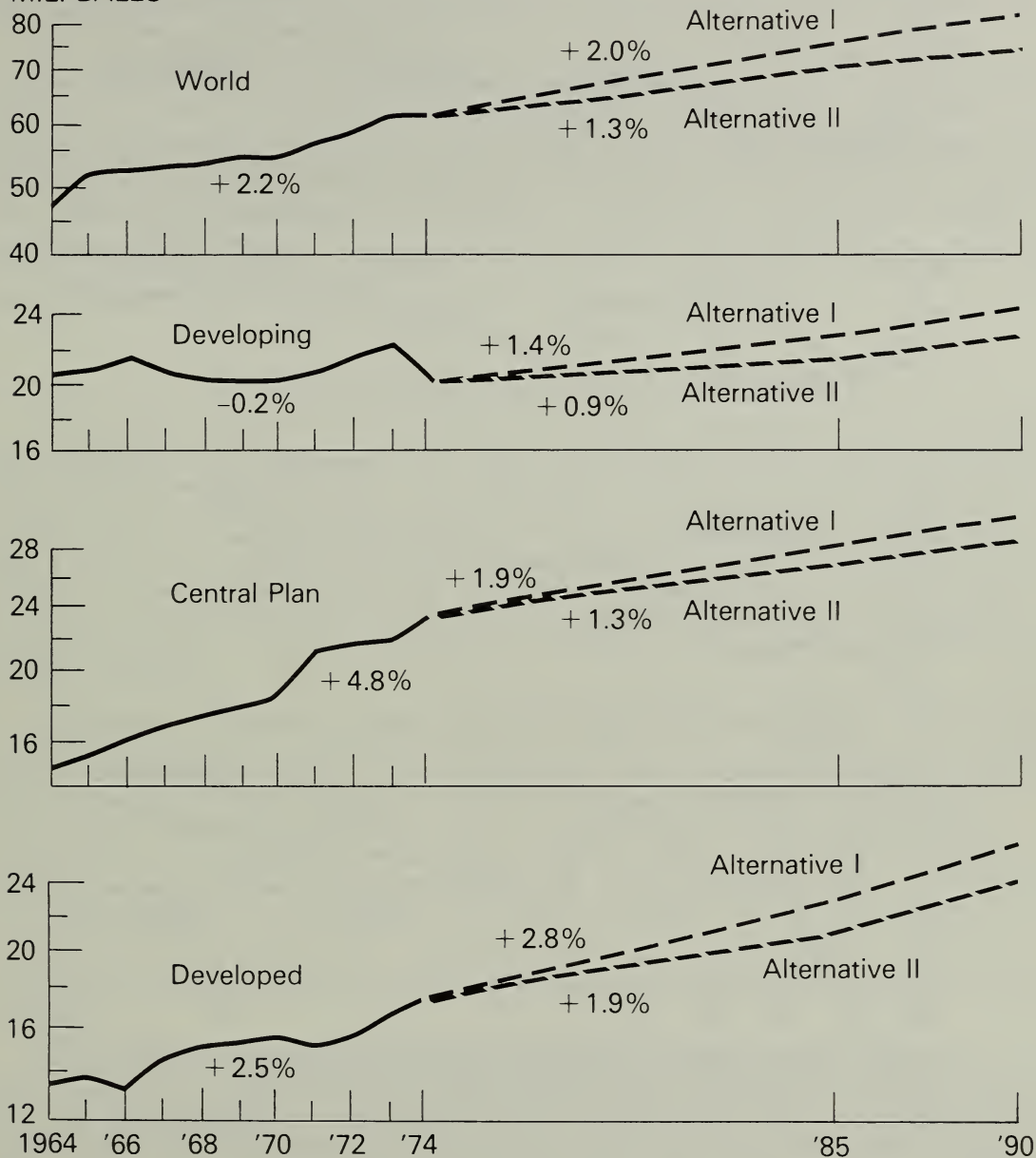
Region <u>2/</u>	Area	Yield	Production
	<u>1,000 kilograms</u>	<u>Kilograms per hectare</u>	<u>Million bales</u>
Developed:			
Actual	5,359	553	13.62
1985 Alt. I	5,136	582	13.72
1985 Alt. II	4,172	582	11.15
1990 Alt. I	5,353	589	14.49
1990 Alt. II	4,101	589	11.10
Developing:			
Actual	18,656	286	24.54
1985 Alt. I	20,939	340	32.71
1985 Alt. II	19,478	331	29.62
1990 Alt. I	21,835	366	36.66
1990 Alt. II	19,597	352	31.69
Central Plan:			
Actual	7,931	629	22.91
1985 Alt. I	8,296	766	29.17
1985 Alt. II	8,296	766	29.17
1990 Alt. I	8,496	831	32.41
1990 Alt. II	8,496	831	32.41
World			
Actual	31,940	416	61.06
1985 Alt. I	34,371	479	75.60
1985 Alt. II	31,946	477	69.94
1990 Alt. I	35,684	510	83.56
1990 Alt. II	32,194	509	75.20

1/ The cotton-to-polyester price ratio is assumed to be 1.15:1. Totals may not add due to rounding.

2/ Actual data are averages of the 1976 and 1977 crop years; some preliminary data are used.

# WORLD COTTON USE: PROJECTED ANNUAL AVERAGE GROWTH RATES

MIL. BALES



△ See footnote end of Figure 5.

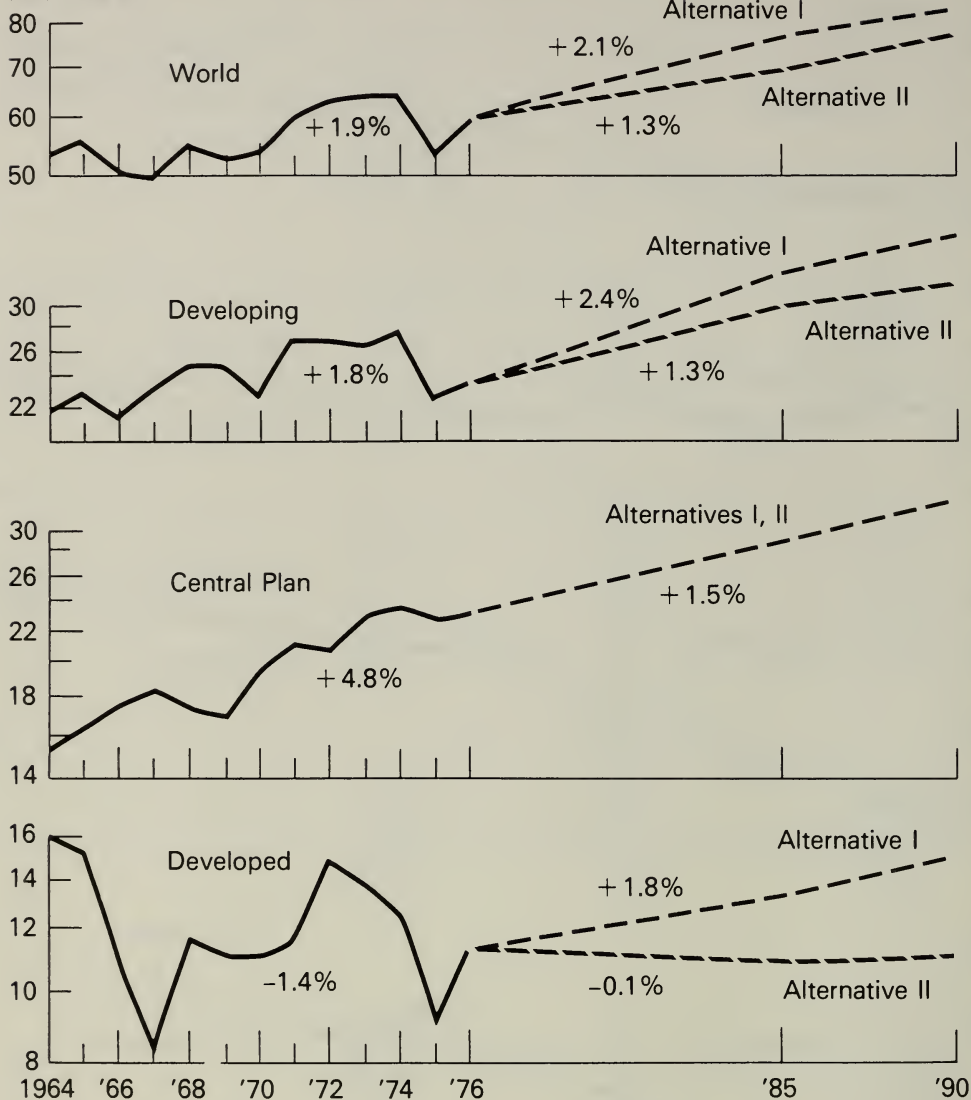
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Figure 4

# **WORLD COTTON PRODUCTION: PROJECTED ANNUAL AVERAGE GROWTH RATES<sup>Δ</sup>**

MIL. BALES



<sup>Δ</sup> Growth rates are computed using predicted values for 1974 (Figures 2 and 4) and 1976 (Figure 5) calculated from trend regressions fitted to the historical data.

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NEG. ESCS 3122-78 (9)

Figure 5



is bracketed by the alternative projected rates. In central plan regions, a declining growth rate similar to the one projected for central plan cotton use is indicated. This decline is partially the result of a smaller yield growth in the PRC compared to its strong historical yield gains. In addition, the tremendous yield gains of the past decade in the U.S.S.R. are not likely to be duplicated over the next decade.

The central plan production projections are assumed to be identical under alternatives I and II and not responsive to changes in projected cotton prices. This assumption is made because the lower level cotton use projections for central plan regions and the rest of the world, if realized, do not necessarily imply concomitant central plan reduced production. The U.S.S.R. has been very successful in increasing area and yield, and the PRC has been very successful in increasing yield, achievements both countries will likely try to maintain. In addition, the foreign exchange earnings from the exports of raw cotton from the U.S.S.R. and processed cotton from the PRC provide incentives for maintaining production despite projections of reduced growth rates for cotton textile use. 3/

### Cotton Mill Consumption and Trade Balances

Cotton mill consumption projections are the most uncertain of all projections. They are based on the rate, over the last two decades, at which individual regions established spindles and looms. The geographic distribution of mill consumption changed between 1960-63 and 1973-76 as follows: (1) in developed regions, the share of world mill consumption fell from 43 to 27 percent, (2) in developing regions, it grew from 27 to 34 percent, and (3) in central plan regions, it grew from 31 to 40 percent. These figures reflect the gravitation of mill capacity toward countries with low wages and government-supported textile industries. Other factors include reduction in textile trade, and desire to satisfy growing domestic demand for more textile products.

Projections (in table 3) under both the demand alternatives show the following patterns in world mill consumption shares by 1990: (1) a continuing fall to about 20 percent in developed regions, (2) a continuing rise to near 40 percent in developing regions, and (3) holding steady at about 40 percent in central plan regions. Developing regions with low wages appear headed for the largest gain in mill consumption. In addition to lower labor costs and higher global cotton demand, this projected gain is made possible by continuing stagnation in the mill industries of developed regions. In developing countries, additional impetus is provided by development of new manmade fiber production capacity and government emphasis on textile production and exports. Moreover, the current trend toward removing impediments to international trade in textiles will promote the exports of developing countries.

These projections imply very strong pressure in developed regions to increase their current net cotton textile trade deficit which stood at 3.3 million bales in 1974. It is projected to continually rise, possibly more than doubling by 1990 under strong demand (alternative I) and to be near this high level even under weaker demand (alternative II). In developing regions, with mill consumption rapidly rising, the 1.7-million-bale surplus of 1974 is projected to more than triple by 1990. For central plan regions, under both alternatives, the 1974 textile trade surplus of 0.9 million bales could nearly double by 1985, but remain at the 1985 level to 1990 as textile imports of the U.S.S.R. and East Europe grow in the latter part of the eighties, which would offset increases in PRC textile exports.

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3/ The assumption of fixed central plan production under alternative II is relaxed, and an examination of the effects on the United States is provided in the next section.

Table 3--World: Cotton supply and utilization to 1985 and 1990 1/

Region 2/	Production :	Net raw cotton exports 3/	Mill consumption :	Net cotton textile exports 3/	Cotton textile use
			<u>Million bales</u>		
Developed:					
Actual	: 13.62	-2.67	15.46	-3.33	19.97
1985 Alt. I	: 13.72	-2.80	16.52	-6.45	22.97
1985 Alt. II	: 11.15	-4.48	15.63	-6.15	21.78
1990 Alt. I	: 14.49	-2.45	16.94	-7.73	24.67
1990 Alt. II	: 11.10	-4.60	15.70	-7.10	22.80
Developing:					
Actual	: 24.54	3.16	21.01	1.71	17.65
1985 Alt. I	: 32.71	3.94	28.77	4.88	23.89
1985 Alt. II	: 29.62	3.49	26.13	4.49	21.64
1990 Alt. I	: 36.66	2.99	33.67	6.11	27.56
1990 Alt. II	: 31.69	2.03	29.66	5.46	24.20
Central Plan:					
Actual	: 22.91	-1.11	24.97	.94	23.10
1985 Alt. I	: 29.17	-1.15	30.32	1.58	28.74
1985 Alt. II	: 29.17	1.00	28.18	1.66	26.52
1990 Alt. I	: 32.41	-.55	32.96	1.62	31.33
1990 Alt. II	: 32.41	2.57	29.84	1.64	28.20
World:					
Actual	: 61.06	--	61.44	--	60.71
1985 Alt. I	: 75.60	--	75.60	--	75.60
1985 Alt. II	: 69.94	--	69.94	--	69.94
1990 Alt. I	: 83.56	--	83.56	--	83.56
1990 Alt. II	: 75.20	--	75.20	--	75.20

1/ The cotton-to-polyester price ratio is assumed to be 1.15:1. Totals may not add due to rounding.

2/ Actual data are averages of the 1976 and 1977 crop years for production, net cotton trade, and mill consumption; some data are preliminary. Remaining data are for the 1974 calendar year.

3/ Minus sign denotes net import balance.

--=Not applicable.

On the raw cotton trade side of the market, the developed regions are projected to remain significantly in deficit for 1985 and 1990 under either demand alternative. Toward the end of the projection period, under alternative I, the high U.S. supply elasticity could be responsible for reducing the deficit if the smaller rate of decline in cotton's market share and trend growth in demand puts pressure on price. Under alternative II, the large increase in the trade deficits primarily results from reductions in U.S. production and exports. Developing regions are projected to increase net exports from the 1976/77-1977/78 average level of 3.2 million bales. Under higher or lower world demand, exports could rise during the projection period, but fall back near or below current levels if mill consumption accelerates as projected.

Developing regions encourage textile production because of its high labor and low capital requirements, and potential capacity for high foreign exchange earnings. Thus, mill consumption is expected to advance faster than either cotton production or end-use consumption. In central plan regions, the 1.1-million-bale import deficit of 1976/77-1977/78 could remain near this level under pressure from the PRC and East Europe, under strong demand (alternative I). In the longer run, the magnitude of the central plan deficit will primarily depend on area and yield responses in the U.S.S.R. and its consequent export policy. Under weaker demand (alternative II) the central plan production projections are assumed to be the same as under strong demand. Hence, the low domestic demand levels mean large increases in exportable production, which explains the change to a net cotton trade surplus under lower demand.

#### World Trade Share of the United States

A measure of the volume of world raw cotton trade and the U.S. trade share may be determined by aggregating individual regional projections. Under alternative I, total exports, assumed to equal imports, are 20.9 and 23.3 million bales in 1985 and 1990, respectively, with the U.S. share about 27 percent. Under alternative II demand, total trade falls to about 18.8 million bales in both 1985 and 1990, and the U.S. share is about 19 percent. These numbers compare favorably with the 18-million-bale level of world exports averaged during 1974-76, and they bracket the U.S. share of 22 percent averaged over this period. The projected decline in the U.S. share under the lower use alternative may be attributed to the U.S. position as one of the most price elastic members, for both demand and supply, of the major cotton exporting countries.

#### THE MARKET FOR COTTON IN THE UNITED STATES

Projections for key market variables are presented and analyzed in view of historical trends and demand and supply determining factors. Some of the assumptions used in alternative I and II projections are altered and the subsequent effects examined.

#### Market Projections

Throughout the seventies, a major development in the U.S. cotton market has been the increased interrelationship with foreign cotton producing and consuming nations. This trend will continue through 1990. Although raw cotton exports will depend on world income, population, and manmade fiber growth, they will occupy an increasingly prominent position in total domestic disappearance. Net cotton textile imports will likely increase.



Two primary issues in the domestic market in 1978 portend further international dependence: U.S. Government attempts to (1) implement the world's most stringent dust standards throughout the cotton processing industry and (2) gradually raise quotas and relax tariffs on imported textiles. Implementation of the dust standards will affect U.S. mill consumption through substitution of manmade fiber and imported cotton yarns for domestic cotton. Bilateral trade agreements provide for moderate yearly increases in quantities of cotton and other textiles allowed to enter the United States from abroad. Tariff negotiations now underway could reduce tariffs. This reduction would further hinder mill consumption by increasing the competitive position of foreign textile producers. The eventual impacts of these measures depend on the degree to which they are imposed. The primary impact on alternatives I and II projections would be the exportation of domestic mill capacity to foreign nations and the consequent alteration of U.S. trade balances. Impacts on longrun projections of production and end-use consumption would be far less significant.

For dust standards, quotas, and tariffs, the current uncertainty concerning legislated levels, areas of coverage, and timing preclude their explicit consideration in the projections appearing in this report. Yet, the apparent certainties that some dust standards will be imposed and trade liberalization will continue have influenced the projections by eliminating from consideration increases in mill consumption above recently experienced levels. With some future Government intervention in the domestic market and the expected competition from manmade fiber, cotton production, mill consumption, and per capita use in the United States are expected to remain near levels averaged since 1974 and could increase slightly by 1990.

#### Fiber Use and Textile Trade

Total fiber use in the United States rose steadily throughout the sixties and early seventies, peaking at 27-million-equivalent cotton bales in 1973. In the face of world recession, fiber use fell in 1974 and 1975 to a low of 22.6 million bales, but rebounded to 26.6 million by 1977. (These totals are not adjusted for changes in manufacturers' and trade inventories.) Despite a high level of per capita income in the United States, this growth implies a per capita fiber use income elasticity higher than that estimated for most other regions of the world (see the appendix for estimated regional income elasticities). Several factors in the United States explain this high response: availability of manmade fiber, a variety of manufactured fiber products available, fashion consciousness, taste changes inspired by heavy textile promotion, the level of wealth, the distribution of income, and the relatively little Government intervention in the textile industry compared with that in many other countries.

Based on increased environmental considerations and continued declining energy availability, an income growth rate of 3.1 percent per year, slightly lower than the 3.5 percent averaged during 1960-76, is used to project U.S. fiber use under alternative I. Under alternative II, a 25-percent reduction, or 2.33 percent per year, is assumed. Projected levels show annual average gains in total fiber use of over 900,000 bales under alternative I and near 700,000 bales under alternative II throughout the projection period (table 4). Annual gains during 1960-77 averaged 750,000 bales with an annual average growth rate of 3.9 percent; alternative I and II projections represent reduced future growth rates of about 3.1 and 2.5 percent, respectively.

The long decline in cotton's share of total fiber use has moderated since reaching 30 percent in 1973; for 1977, it was 27 percent. Despite an expected rise in manmade fiber price relative to cotton price, a continued decline in cotton's share through 1990 is foreseen. Since many end-use markets have already completely or extensively substituted manmade fiber for cotton, moderate reductions to cotton shares of 24 percent in 1985 and 22 percent in 1990 are projected. These shares provide for small



Table 4--United States: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports	Mill consumption	Net cotton textile exports	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms/ hectare	1,000 bales	1,000 bales	1,000 bales	1,000 bales	1,000 bales	Kilograms	1,000 bales	Kilograms	Percent
1960	6,195	500	14,238	6,728	8 355	-40	8,858	10.67	13,762	16.58	64
1965	5,510	591	14,938	2,917	9,596	-390	9,811	10.99	18,343	20.55	53
1970	4,514	491	10,192	3,860	8,204	-550	8,579	9.12	21,147	22.47	41
1974	5,086	494	11,540	3,892	5,860	-229	7,123	7.32	23,497	24.14	30
1975	3,560	508	8,302	3,219	7,250	-308	6,613	6.74	22,554	22.99	29
1976	4,417	521	10,581	4,746	6,674	-616	7,728	7.82	25,198	25.51	31
1977	5,374	583	14,389	5,479	6,509	-625	7,255	7.29	26,580	26.69	27
1985											
Alt. I	4,784	566	12,436	5,636	6,800	-1,344	8,144	7.54	33,934	31.40	24
Alt. II	3,890	566	10,112	3,712	6,400	-1,280	7,680	7.11	31,999	29.61	24
1990											
Alt. I	4,985	572	13,095	6,295	6,800	-1,711	8,511	7.52	38,688	34.20	22
Alt. II	3,824	572	10,046	3,646	6,400	-1,413	7,813	6.91	35,517	31.40	22

1/ Minus sign denotes net imports.

Sources: Cotton area, yield, production, trade, and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAO, and 1975-77 from CED/ESCS.

gains from 1977 levels in U.S. domestic cotton use by 1985 and 1990 under alternative I; under alternative II, the gains are about twice as large. Future per capita cotton use would range from 6.9 to 7.5 kilograms, bracketing the actual 1977 level of 7.3.

Major considerations in projecting U.S. mill consumption are the mill response to rising manmade fiber prices, levels of protection in textile trade, and environmental legislation, specifically cotton dust regulations. Based on a more favorable cotton-to-polyester price ratio, 1.15:1, than the 1.35:1 averaged during 1974-76 and a stabilized per capita cotton use, mill consumption could reach 6.8 million bales in 1985 and 1990 under alternative I. This implies a deficit net textile trade balance near 1.3 million equivalent bales in 1985, rising as high as 1.7 million bales in 1990. Numerous combinations of import and export levels yield these trade figures.

Although only net balances are projected, the reader who wants an idea of the relevant ranges of import and export growth that make up the projected net balances can calculate a sample set of projected growth rates from actual 1977 data. Rates consistent with the alternative I trade balance projections are near an 0.5-percent annual expansion of cotton textile exports and close to a 5-percent annual expansion in imports. Such a possible export increase reflects a continuing reduction in U.S. production cost relative to that of many Western European countries (for certain types of textiles), desirability of American-quality textiles, and expected increases in U.S. textiles exported to be made into apparel and imported back to the United States (known as 807 imports).

Such a possible rate of increase in imports is slightly less than actually experienced since 1968, when U.S. mill consumption of cotton began a rapid contraction; it is also less than the maximum of 6 percent per year, the bilateral agreement growth rate guideline of the Multifiber Arrangement. However, the increase does represent a growth in the import share of domestic cotton use from 19 percent in 1976 to 24 percent in 1985 and 29 percent in 1990.

Under alternative II, mill consumption is projected at 6.4 million bales in 1985 and 1990. The net textile trade deficit ranges from 1.3 million bales in 1985 to 1.4 million bales in 1990. As might be expected, these deficit levels are less than those projected under alternative I. Reasonably expected textile export and import annual growth rates for which the projected deficits are consistent are 0.5 percent and 3.5 percent, rates smaller than those that yield the higher demand deficits. Under these growth rates, the import share of domestic cotton use would rise to 22 percent in 1985 and 24 percent by 1990.

#### Cotton Production and Trade 4/

U.S. cotton production during the last decade continued to be characterized by the same production shifts that marked earlier years. The Southwest and Delta regions each have maintained their shares of total production at about one-third. The remaining third, equally divided between the West and Southeast 25 years ago, is now almost entirely accounted for by the West. In 1977, the West's share had reached 29 percent of total production while the Southeast was down to 4 percent. Since yields have remained relatively constant in the West and trended up slightly in the Southeast, these production changes have resulted from harvested acreage shifts from east to west (fig. 6).

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4/ U.S. cotton production regions include the following States: Southeast-Virginia, North Carolina, South Carolina, Georgia, Florida, and Alabama; Delta-Missouri, Arkansas, Tennessee, Mississippi, Louisiana, Illinois, and Kentucky; Southwest-Texas, Oklahoma, and Kansas; West-California, Arizona, New Mexico, and Nevada.

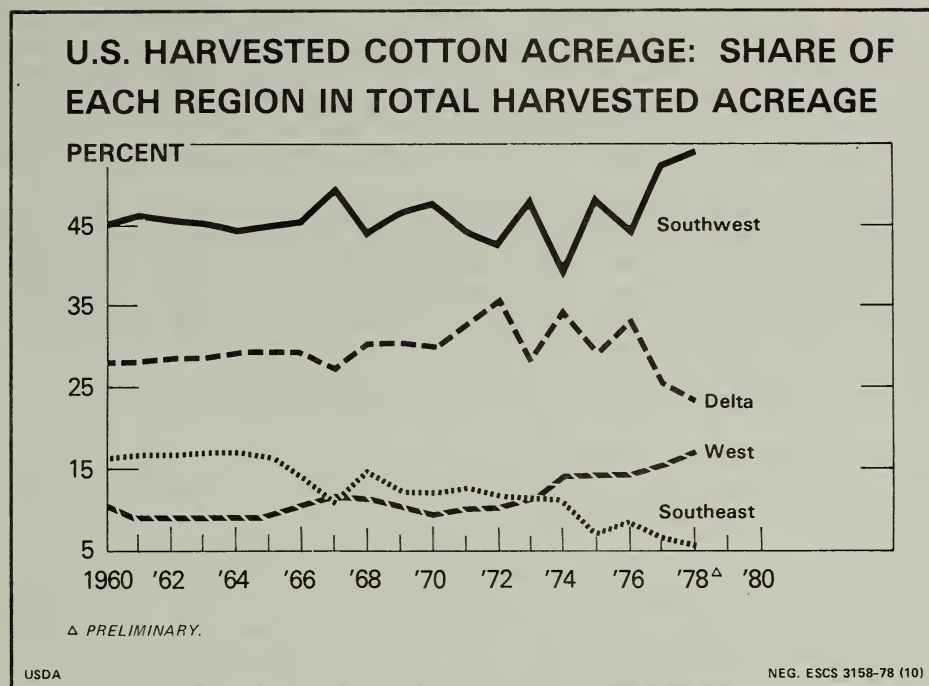


Figure 6

The acreage shifts primarily reflect the ideal cotton growing conditions of the West. A long growing season, fertile soils, large flat contiguous areas over which to spread capital costs, little damage from pests, and moisture control have resulted in higher yields and lower per unit production costs, on average, than elsewhere in the Nation. In addition, quality of western cotton has usually meant higher prices received for the growers. Although yields were above normal for the Delta and the Southwest and below normal for the Southeast in 1977, the following production costs, in cents/pound, based on harvested acreage for 1977, excluding land, reflect the cost disadvantage of the Southeast: West, 50; Southwest, 46; Delta, 56; Southeast, 99.

Government programs have also provided an additional impetus for westward production migration. Marketing quotas before 1971 discouraged western expansion beyond allotments. Although the quotas were eliminated in 1971, minimum 15 cents/pound program payments with bonuses for small farmers maintained the pre-1971 level of planted acreage in the Southeast until 1974, when these policies were eliminated.

Acreage shifts will likely continue, although more slowly, from the Southeast to California. California's cotton expansion will be limited by the availability of irrigation water, especially in the Imperial Valley. In the San Joaquin Valley, water is an important determinant of total acreage. However, returns on competitive crops are expected to have more impact in explaining amounts of acreage planted to cotton than in the Imperial Valley where vegetable, vine, and tree crops are well established. This shift implies a continued rise in average U.S. yields.

The rise, however, will be mitigated, to some extent, by long-term yield and/or acreage reduction in the Southwest's irrigated cotton region (Arizona, New Mexico, and far western Texas) and the Texas Plains where yields now average 800 kilograms/hectare



or more. These areas face water-related problems, including water availability, increased salinity, and rising costs, because of increased pumping lifts from a declining water table and rising natural gas prices. In the longer run, some cotton acreage reductions may occur in the most critical areas; in other areas, less-intensive water use will probably be reflected in reduced yields but not significant acreage changes, as cotton is expected to be the best restricted-water alternative.

In the Delta, the remaining major cotton-producing region, acreage or yield levels are not projected to change significantly from those averaged during the last several years. Area stability is based on the comparative advantage of cotton, the assumption of no chronic, significant change in the cotton/soybean price ratio, and only moderate increases in rice production. With the above forces in mind, and no major breakthroughs in development of multiadversity cotton varieties expected, yields in 1985 and 1990 are projected to be 566 and 572 kilograms/hectare. These levels are slightly below the unusually high yield of 583 kilograms/hectare in 1977/78.

For harvested acreage, the 1972/73-1977/78 average, 4.76 million hectares, was taken as a level from which price-induced changes could be calculated. This average is assumed to hold for 1985 and 1990 and for alternatives I and II in view of little or no apparent trend in acreage in the past decade, after acreage has been adjusted for effects of changing prices and Government policies. A longrun price elasticity of acreage response of 1.71 is used (5). 5/ Under alternative I, at the world market clearing prices, about 30,000- and 230,000-hectare increases over the 1972/73-1977/78 average are projected for 1985 and 1990. The implied production forecasts of 12.8 and 13.1 million bales also exceed the 1972/73-1977/78 average of 11.9 million bales. Under lower demand, 1985 and 1990 area projections are 865,000 and 671,000 hectares below the 1972/73-1977/78 average while production would fall about 1.8 million bales below the average.

Potential U.S. net cotton exports, defined as the difference between production and mill consumption, vary from 3.6 to 6.3 million bales, compared with 4.8 million bales averaged during 1972/73-1977/78. These net figures are virtually all exports since imports are minimal. Under alternative I, world cotton use rises strongly. The large production responsiveness of the United States to such conditions in the world market suggests increasing exports as the projection period proceeds. Under alternative II, the foreign production increases throughout the projection period keep pace with advances in foreign cotton use. This implies little change, over time, in the depressed 3.6- to 3.7-million-bale level of U.S. exports.

#### Effects of Possible International Demand and Supply Developments

The alternative I and II projections show the size of the U.S. cotton market depends greatly on the rate of growth of world demand for cotton and the foreign production response. Besides changes in income, other developments could affect the U.S. cotton market. Three possible developments are examined.

#### Alternative Cotton/Polyester Price Relationships

Projections for U.S. production and utilization assume a cotton-to-polyester price ratio of 1.15:1. Considerable uncertainty exists regarding the future movement of polyester price because of impacts possible from energy availability. Thus, the sensitivity of U.S. market variables to alternative polyester price movements was investigated (table 5). A price-dependent mill demand was used; based on previous research (4), a mill demand price elasticity of -0.25 was assumed. This elasticity

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5/ Underscored numbers in parentheses refer to references listed at the end of this report.

Table 5--United States: Supply and utilization projections to 1985 and 1990 under alternative cotton and polyester prices <sup>1/</sup>

Alternative	Area : harvested :	Yield : hectare :	Production : cotton :	Net raw : cotton : : exports :	Mill : 2/ :	Net cotton : textile : : exports :	Per capita : cotton : : textile use :	Cotton's share
	1,000 : hectares :	Kilograms/ : hectare :			Million bales		Kilograms	Percent
1985:								
Alternative I	4,784	566	12.44	5.64	6.80	-1.34	8.14	24
Low cotton-to- polyester price	4,899	566	12.73	5.78	6.95	-1.50	8.45	25
High cotton-to- polyester price	4,669	566	12.14	5.49	6.65	-1.19	7.84	23
1990:								
Alternative I	4,985	572	13.10	6.30	6.80	-1.71	8.51	22
Low cotton-to- polyester price	5,113	572	13.43	6.48	6.95	-1.91	8.86	23
High cotton-to- polyester price	4,856	572	12.76	6.11	6.65	-1.51	8.16	21

<sup>1/</sup> The alternative I (base) solutions assume a cotton-to-polyester price ratio of 1.15:1. This is varied + 0.1 to obtain the other two alternatives.

<sup>2/</sup> A mill consumption elasticity, with respect to the cotton-to-polyester price ratio, of -0.25 is assumed.

could change to the extent that the historical substitution relationship shared by cotton and polyester moves in the direction of complementarity as blending ratios become standardized.

Using alternative I demand, the cotton-to-polyester price ratio is altered by 0.1 around the 1.15:1 level. Thus, the ratio for the high cotton-to-polyester price alternative is 1.25 and for the low cotton-to-polyester price alternative, 1.05. From these levels, market-clearing cotton supply prices may be determined and implied polyester prices derived. For the range of possible cotton prices, the different implied polyester prices appear to act as reasonable bounds on expected price movement based on currently available polyester production cost studies and the actual average polyester price of 51 cents/pound during 1976-77. It can be shown that relatively larger changes in the implied polyester price than in the cotton price occur when their ratio is varied. This results from use of an aggregate world supply price elasticity that exceeds the world demand price elasticity.

A change in price effects a change in the same direction of 300,000 to 350,000 bales in 1985 and 1990 in both cotton production and cotton textile use. However, only half of the production and use changes are reflected in increases or decreases in farm sales to domestic mills. The other half would be reflected in changes in trade. With a mill consumption level of 6.8 million bales, the implied longrun price elasticity of export demand facing the United States, with average values of projected variables, is -0.68.

#### Alternative Yield Increases in Developing Countries

Since many of the regional yields used in deriving the accepted projections are based on judgment, a variety of subjective and empirically derived factors influence the determination of the projected yields. An important question to answer when projecting yield is whether more or less intensive use of production inputs on cotton area will result. For all 21 regions, increases in yields over past levels are projected; some are small, some moderate, and a few will require pervasive changes in input-supplying and related industries. In all cases, the yield projections imply a judgment as to a region's rate of agricultural sector growth.

Since it was one of the objectives of this report and for several other reasons, it is of interest to analyze the effects on U.S. domestic cotton acreage, production, and so on, of larger than expected agricultural sector (hence, yield) growth in developing countries. The developing countries, through national and international agencies, are developing plans that place some emphasis on cotton production in developing countries. From the U.S. cotton farmers' viewpoint, such an analysis may be seen as a possible worst-case alternative. Finally, from a technical viewpoint, many of the accepted yield projections are below linear trend projections. The latter are often used as a base or standard for comparison.

The issue of unusually large foreign production increases is examined by increasing the yield variable in developing regions. The projected yields of developed and central plan countries are held fixed at the levels accepted for alternatives I and II. The yields of developing countries are increased over the accepted levels by a measure based on the historical variability of actual past yields. <sup>6/</sup> For 1985, they are raised from the projected 344 kilograms/hectare to 367

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<sup>6/</sup> The measure used is one standard error estimated from trend (SEET). Regional SEET's appear in the appendix. At the equilibrium price and world production levels of alternative I, the increase is 2.3 million bales in production in developing regions in 1985 and 2.5 million bales in 1990. This is a yield increase of about 7 percent in developing countries above what would have been projected otherwise. The initial supply increase will, of course, be mitigated by the resulting decline in price and the consequent contraction in planted area.



kilograms/hectare. For 1990, they are increased from 367 to 392 kilograms/hectare. Alternative I demand levels are used in the analysis (table 6). 7/

The additional increase in foreign production reduces U.S. cotton exports about 1.2 million bales in 1985 and 1990. Domestic consumption, however, increases under a declining world cotton price. Thus, production declines less (1.1 million bales) than exports. In addition to the effect of lost exports, the value of production is eroded by the close to 4 cents/pound decline in the equilibrium world market clearing price. The declines in U.S. production and world price are about 8 to 9 percent and 6 percent, respectively.

For additional perspective, the results under high yields may be compared with the current situation. Over 1976/77-1977/78, exports and production in the United States averaged 5.23 and 12.49 million bales. The high yield situation (table 6) represents, in 1990, declines of 2 percent in U.S. exports and 4 percent in U.S. production.

#### Shifts in Production in Central Plan Countries Under Lower Cotton Demand

The lower demand alternative examines the effects of reduced world demand for cotton. As previously described, the demand-side reduction may be viewed as resulting from either a (1) reduction in income growth rates, hence, reduction in total fiber and cotton use or (2) the alternative I total-fiber use projection combined with a smaller cotton share projection (see the appendix). In the United States, for example, cotton's shares under the first interpretation are 24 and 22 percent in 1985 and 1990, respectively. Under the second, they would be 23 and 20 percent, respectively. The global reduction in cotton use under lower demand, then, puts downward pressure on prices and net returns to cotton producers.

The lower demand alternative, however, makes no allowance for reductions, below those of the higher demand projections, in production in central plan regions. Because of reduced farm revenues, reductions in area harvested in both developed and developing countries were made under alternative II. Such a response for central plan regions, while not necessarily expected, could appreciably increase U.S. exports. However, it is possible that reductions in cotton use in central plan regions could reduce pressure for more planted area. Realization of the reduced central plan use assumed under alternative II might be predicated on lowered production. Moreover, reduced global use might be perceived by planners as affecting potential Soviet export sales and causing area restriction. Hence, we examine the sensitivity of the low use projections to a reduction in central plan production (table 7).

For 1985, area harvested in the U.S.S.R. is taken to be the 1971/72-1976/77 average plus one-half the increase above this level that is projected for 1985 under the higher demand alternative. To this, one-half the projected increase from 1985 to 1990 under higher demand was added to obtain the 1990 lower demand area projection. The PRC area for 1985 and 1990 was taken to be the 1971/72-1976/77 average area. Total central plan production, then, is 0.86 and 1.17 million bales below the alternative I projections in 1985 and 1990, respectively.

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7/ Some regional base harvested areas throughout the world used in the alternative I analysis are reduced for the alternative II analysis. Yields, however, remain unchanged. This may be optimistic in that the lowered net returns to producers under alternative II could result in less intensive input application and revision of Government plans to promote increases in irrigated area, reduced rate of adoption of cotton farming technology, and so on. Thus, a high-yield alternative in developing countries under alternative II income growth was not examined; however, such an analysis would certainly show reduced U.S. cotton production and export projections, well below their already depressed alternative II levels of about 10 and 3.7 million bales.

Table 6--United States: Supply and utilization projections to 1985 and 1990 under a high-yield alternative in developing countries 1/

Alternative	Area : harvested	Yield :	Production: :	Net raw : cotton	Mill : consumption	Net cotton: : textile	Per capita: : cotton	Cotton's share
	1,000 : hectares	Kilograms/ : hectare		exports: :	2/ :	exports : use	textile use:	
					Million bales		Kilograms	Percent
1985:								
Alternative I	4,784	566	12.44	5.64	6.80	-1.34	8.14	24
High yield	4,350	566	11.31	4.41	6.90	-1.43	8.33	25
1990:								
Alternative I	4,985	572	13.10	6.30	6.80	-1.71	8.51	22
High yield	4,577	572	12.02	5.12	6.90	-1.81	8.71	23

1/ The alternative I and high yield solutions assume a cotton-to-polyester price ratio of 1.15:1.

2/ A mill consumption elasticity, with respect to the cotton-to-polyester price ratio, of -0.25 is assumed.



Table 7--United States: Supply and utilization projections to 1985 and 1990 under the lower cotton use alternative 1/

Alternative	Area :harvested:	Yield	Production	Net		Mill		Net		Cotton		Cotton's share
				:raw :cotton:	:cotton:	:consumption 2/	:cotton:	:textile: :exports:	:textile: :use:	:cotton: :use:	:textile: :use:	
	: :hectares	Kilograms/ hectare		-----	Million bales	-----		-----	Kilograms		Percent	
1985:												
Alternative II	3,890	566	10.11	3.71	6.40	-1.28	7.68	7.11	24			
Alternative II and reduced central plan production	4,110	566	10.68	4.33	6.35	-1.25	7.60	7.01	24			
1990:												
Alternative II	3,824	572	10.05	3.65	6.40	-1.41	7.81	6.91	22			
Alternative II and reduced central plan production	4,084	572	10.73	4.38	6.35	-1.33	7.68	6.79	22			

1/ Low-use solutions assume cotton-to-polyester price ratio of 1.15:1.

2/ A mill consumption elasticity, with respect to the cotton-to-polyester price ratio, of -0.25 is assumed.

The United States would be a major beneficiary of reduced U.S.S.R. and PRC production. Net textile imports would fall about 50,000 bales and cotton exports rise about 650,000 bales. This rise represents more than half the reduction in central plan production.

## THE MARKET FOR COTTON IN FOREIGN COUNTRIES

The treatment given to each of the 20 foreign regions differs somewhat from that given the United States. The objective is not to assess each country's future behavior under different sets of world conditions, but to examine factors in the foreign sector that could bear on the United States in the future, and to provide basic cotton market projections to 1985 and 1990. We analyze the contribution of each foreign geographic region to the aggregated foreign consumption/production balance facing the United States.

To appeal to a general readership, we do not present the projections in exhaustive detail. Historical data are discussed and trends are analyzed to provide a broad understanding of each region's market and the general factors underlying the projections.

The projections suggest which countries and regions have the potential to expand their cotton sectors and which are likely to contract them. The projections also indicate the location and size of future foreign markets for U.S. cotton and the primary competition in these markets.

The format of analysis for each region is identical. A supply and utilization table presents past data and alternative projections. Perspective for the projections is provided through sections on the domestic cotton textile market, manmade fiber competition, textile trade, mill consumption, and raw cotton supply.

### Developed Countries

Overall, the foreign developed countries will continue to produce only small quantities of cotton and to increase their current raw cotton and cotton textile trade deficits.

#### European Community (EC)

The Domestic Market.--Domestic consumption of cotton textiles averaged 6.5 million bales annually during 1975-77, compared with 5.9 million in 1972-74 and 5.4 million in 1967-69. From 1967 to 1974, consumption of other fibers, primarily manmade, rose extremely fast, from 9 million bales to 11.7 million. Per capita cotton consumption, generally declining in the past, rose in 1976 and 1977 with massive net imports of cotton manufactures (table 8). As population and income grow, total fiber demand will increase; the market for cotton will remain strong, with per capita cotton use above 5.25 kilograms in 1985, and up to 5.5 in 1990.

Competition from Manmade Fibers.--The European Community has a large, long-established, manmade fiber industry. After many years of competition, cotton's proportion of domestic textile markets in 1974 was down to one-third. In recent years, overcapacity and intense competition, particularly from imported manmade fiber textiles, have plagued the industry, and there have been heavy financial losses and some closing of plants. In France, production of noncellulosic fiber reached only 66 percent of capacity in 1977; in the Federal Republic of Germany, 72 percent; in the United Kingdom, 58 percent; and in Italy, 52 percent.

Table 8--European Community: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare			1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	22	273	28	-5,806	6,053	252	5,752	5.39	11,354	10.65	51
1965	14	286	18	-5,094	5,218	-472	5,600	5.01	13,502	12.07	41
1970	5	200	5	-4,400	4,382	-1,032	5,727	4.96	15,946	13.81	36
1974	--	--	--	-3,564	3,583	-1,881	5,927	5.00	17,129	14.46	35
1975	--	--	--	-3,850	3,716	-2,347	6,063	5.12	NA	NA	NA
1976	--	--	--	-3,509	3,755	-3,109	6,864	5.79	NA	NA	NA
1977	--	--	--	-3,564	3,400	-2,949	6,349	5.34	NA	NA	NA
1985: Alt. I	--	--	--	-3,200	3,200	-3,369	6,569	5.27	21,191	17.00	31
Alt. II	--	--	--	-3,100	3,100	-3,185	6,285	5.04	20,273	16.76	31
1990: Alt. I	--	--	--	-3,200	3,200	-3,800	7,000	5.49	23,332	18.30	30
Alt. II	--	--	--	-3,000	3,000	-3,577	6,577	5.16	21,922	17.19	30

1/ Minus sign denotes net imports.

-- = Insignificant figure.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

In the older rayon industry, many plants have been closed. These difficulties in the manmade fiber industry have tended to hold down prices for the fibers and have competitively restrained growth in mill demand for cotton. Projected gains in manmade fiber use, particularly in carpets and industrial uses, point to a further decline in cotton's percentage of the total textile market.

Trade in Textiles.--The EC's domestic consumption of textiles in recent years has been increasingly supplied by imports. Low-cost cotton yarns, notably from Turkey, Greece, and Brazil, and cotton fabrics from India, Pakistan, Hong Kong, the PRC, and several other developing countries, the United States, and Eastern Europe, have been entering the EC in large quantities. Gross imports of cotton yarn and fabrics into EC countries totaled the equivalent of 3.8 million bales in 1977. Apparel and other cotton manufactures are also heavily imported.

Although EC countries export considerable quantities of fabrics and finished goods, shipments are much smaller than several years ago, and the textile import balance shows a heavy deficit.

Mill Consumption.--With foreign cotton textiles taking more of the EC market, EC imports of raw cotton and mill consumption have declined. Cotton mill use in the United Kingdom is now only about one-fourth the 2-million-bale level of the late forties. France and the Federal Republic of Germany each had a relatively steady cotton mill use of about 1.1 million bales through the decade ending in the early seventies, but in the last two cotton seasons the average has dropped under 950,000 bales. Italy's cotton use, erratic but generally about 1 million bales in the early sixties, is now about 15 percent less. In other EC countries, peak cotton consumption occurred in the fifties and sixties. Mill consumption in the EC has declined from 5.2 million bales in 1965/66 to 4.4 million bales in 1970/71, and 3.6 million in 1977/78.

To minimize further losses, the EC restricted textile imports in 1977. Subsequently, bilateral agreements were concluded with many of the exporters, and these agreements limit allowable imports more strictly than before. The EC refused to renew the international Multifiber Agreement, which provides international rules governing import restrictions, until the bilateral agreements were concluded and until the agreement was amended with escape clauses allowing increased protection of endangered industries. The new measures protect the EC's cotton spinning and weaving industries particularly, by providing relief from massive import pressures, and they should induce a restructuring and increased investment in the EC's textile industries. Nevertheless, considering the pressures to promote trade with developing countries and the provisions of present agreements, net cotton textile imports will likely rise gradually and mill consumption continue to fall in the years ahead.

The EC produces no cotton, except Italy's 1,000 to 2,000 bales. Thus, raw cotton mill consumption nearly completely depends on imports. With projected moderate gains in cotton textile use and gradual gains in imported cotton textiles, EC mill consumption (and imports) of raw cotton in 1990 could reach over 3 million bales, but be below the 3.6 million reached in 1977/78.

#### Other Western Europe

This disparate group of countries includes Iceland, Norway, Sweden, Finland, Switzerland, and Austria, which import all of their mill requirements and many of the textiles they consume; Portugal, which produces virtually no cotton but is a major textile exporter; Spain, which produces much of its cotton and exports more textiles than it imports; and Greece, which is an exporter of both raw cotton and cotton textiles.



The Domestic Market.--Domestic consumption of cotton textiles in Other Western Europe rose slowly from 1.42 million bales during 1967-69 to 1.77 million during 1972-74 and 1.82 million during 1975-77 (table 9). Fiber consumption, other than cotton, largely manmade, increased twice as rapidly, from an average of 2.15 million bales during 1967-69 to 3.23 million in 1972-74. Generally, per capita consumption of both cotton and fibers was slightly below the EC average.

With a slight gain in population and a moderate gain in per capita incomes, the consumption of cotton textile products should gain moderately in the years ahead.

Competition from Manmade Fibers.--Some of the countries are too small to operate viable manmade fiber industries. In the region as a whole, the industry, as in the EC, is suffering from overcapacity and intense competition. Prices for manmade fibers, because of government regulations and higher costs, are somewhat higher than in the EC.

Mill Consumption.--Over three-fourths of the mill consumption in Other Western Europe is in Greece, Spain, and Portugal, each using over half a million bales in 1977/78.

Greece is the only country in the region whose mill consumption of cotton has risen rapidly, doubling from 1971 through 1977. Future expansion may be slower because half of Greece's cotton yarn production is exported, largely to the Netherlands, France, the Federal Republic of Germany, and other EC countries. These countries have curbed imports from Greece, but that country's prospective full entry into the EC assures that the Greek market share will be maintained. Greek exports of cotton fabrics are small but may expand. Shipments of yarn and textiles to the Soviet Union and Eastern Europe could grow because of Greek government incentives to exporters for shipments to these countries. Cotton comprises two-thirds of Greece's mill consumption of fibers.

Spain's mill use of cotton in the decade ending in 1977 has been basically constant. Most cotton textile production is used domestically; about one-sixth of the yarn is exported, mainly to northern Europe. Mill consumption of cotton and manmade fibers in 1977 totaled about 400,000 tons (1.8 million bales); cotton accounted for less than one-third. Further replacement of cotton in mill consumption should be difficult. While cotton should benefit from increased demand for textiles, Spain will likely have continued difficulty competing in the export market.

Portugal's mill consumption of cotton in recent years has fluctuated between 475,000 and 550,000 bales annually, peaking in 1973. About one-fourth of its cotton yarn production is exported as yarn and cloth. Exports are less than half their level in 1973, because of import restrictions in northern European markets, increased competition from other countries in these markets, and difficult political conditions, for a time, in Portugal. Cotton constitutes over half Portugal's mill consumption of all fibers.

The other countries in this region have small, specialized cotton mill industries. Consumption in Norway and Sweden dropped 50 percent from 1970 to 1974, but use in Austria, Switzerland, and Finland has been maintained. Future consumption will depend largely on whether governments will continue to want strong textile businesses.

In sum, mill consumption of cotton in Other Western Europe in 1985 and 1990 will likely range from slightly to moderately higher than in 1977.

Supply of Raw Cotton.--Greece produces about 80 percent and Spain, 20 percent of the cotton in this region. Greece's area grew rapidly in the fifties, peaking at 231,000 hectares in 1963; down to 136,000 in 1975; back to 183,000 in 1977, and down

Table 9--Other Western Europe: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare	1,000 bales					Kilograms	1,000 bales	Kilograms	Percent
1960	416	325	620	-1,074	1,585	59	1,470	4.21	2,574	7.37	57
1965	334	464	712	-955	1,649	7	1,614	4.44	3,361	9.25	48
1970	233	708	758	-804	1,713	62	1,550	4.12	4,182	11.10	37
1974	255	725	850	-1,084	1,810	-27	1,804	4.65	5,100	13.16	35
1975	211	791	767	-1,212	1,947	11	1,695	4.32	NA	NA	NA
1976	199	759	694	-1,253	2,108	51	1,909	4.82	NA	NA	NA
1977	249	803	919	-1,273	2,136	101	1,865	4.66	NA	NA	NA
1985:											
Alt. I	239	840	923	-1,289	2,212	159	2,053	4.94	7,025	16.90	29
Alt. II	197	840	762	-1,284	2,046	94	1,952	4.70	6,609	15.90	29
1990:											
Alt. I	249	875	1,000	-1,400	2,400	133	2,267	5.28	8,150	19.00	28
Alt. II	194	875	781	-1,379	2,160	71	2,089	4.87	7,441	17.35	28

1/ Minus sign denotes net imports.

NA = Not available.

Source: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

to 158,000 in 1978. Yields and production have continued to advance as a result of improved varieties, more fertilizer, and additional irrigation and credit. About 93 percent of Greece's cotton area now is irrigated, and production in 1977/78 was at a record 661,000 bales. As Greece's usable land area is limited and yields are already high, not much further expansion in cotton production can be expected.

In Spain, the cotton area declined from a peak of 346,000 hectares in 1962 to 66,000 in 1977. High labor and other rising costs have caused farmers to plant other crops yielding higher net returns. A reversal of the downward trend in cotton relative to competing crops, such as corn, will depend on the level of support prices and input subsidies. Recent government policy, aimed at reducing Spain's agricultural trade deficit, should imply some recovery in cotton cultivation, possibly as much as 50 percent. Spain's production in 1977 of 157,000 bales compares with a 1962 peak of 517,000 bales.

Other Western Europe had a net import balance of 1.1 million bales of raw cotton in 1974 and 1.25 million bales in 1977. Net imports in 1985 and 1990 should be at least this large.

### Japan

The Domestic Market.--Japan's domestic absorption of cotton textiles rose from an average of 2.6 million bales in 1967-69 to 3.8 million in 1972-74 as a result of very strong domestic demand and a government decision to permit record levels of imports in 1972 and 1973. With the subsequent economic slowdown, cotton textile consumption subsided to an average 3.2 million bales in 1975-77 (table 10). Future growth is expected to be slow.

Competition from Manmade Fibers.--Japan has one of the world's largest manmade fiber industries, accounting for some 15 percent of world productive capacity. Competition between cotton and manmade fiber is at an advanced stage so that cotton's proportion of the Japanese market may not decline very much in the years ahead, unless manmade fiber for carpet and household uses greatly expands (2). Carpeting, about one-fourth of U.S. fiber use and very little of Japan's, accounts for about half the difference between Japanese and U.S. per capita consumption of all fibers. Attempts are now underway to reduce Japan's current surplus production of manmade fiber and to consolidate operations into fewer production and marketing firms.

Trade in Textiles.--In recent years, Japan has changed from being a massive net exporter of cotton textiles to being in a position of near balance between exports and imports. Imports have risen and exports declined as a result of Japan's rapidly rising wage rates and other production costs, the rising value of the yen, and the emergence of large, competitive textile industries in other countries.

Imports of cotton products rose from an annual average of 94,000 equivalent bales over 1967-69 to a peak of 1.1 million bales in 1973. From 1974 to 1977, imports of cotton textiles varied between 450,000 and 615,000 bales. South Korea and Pakistan are the principal sources of cotton yarn; the PRC and Taiwan, the leading sources of cotton fabric. The future of textile imports will depend primarily on the quantity that the Japanese Government decides to allow into the domestic market. As Japan is now a high-technology country, it could choose to allow increased imports of relatively labor intensive cotton textiles, particularly from such countries as South Korea and the PRC, in the interest of selling plants and machinery to those countries. Or the government could choose a protectionist attitude to promote the domestic industry. In our study, the former behavior was assumed, and textile imports in 1985 and 1990 are projected to be between 800,000 and 900,000 bales.



Table 10--Japan: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990 <sup>1/</sup>

Year	Net raw cotton exports <sup>2/</sup>	Mill consumption	Net cotton textile exports <sup>2/</sup>	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare	1,000 bales	Kilograms	Kilograms	1,000 bales	Kilograms	Percent
1960	-3,537	3,426	940	2,139	4.95	4,337	10.03	49
1965	-3,077	3,201	1,104	2,257	4.97	4,927	10.85	46
1970	-3,670	3,541	491	2,830	5.91	7,156	14.94	40
1974	-3,478	3,534	-107	3,183	6.29	7,280	14.38	44
1975	-3,224	3,244	79	3,165	6.17	6,164	12.02	51
1976	-3,128	3,351	-42	3,393	6.55	7,425	14.33	46
1977	-2,760	3,077	161	2,916	5.57	NA	NA	NA
1985:								
Alt. I	-3,507	3,507	-403	3,910	6.92	9,537	16.88	41
Alt. II	-3,352	3,352	-392	3,744	6.63	9,132	16.16	41
1990:								
Alt. I	-3,700	3,700	-551	4,251	7.30	10,628	18.25	40
Alt. II	-3,390	3,390	-580	3,970	6.82	9,925	17.04	40

<sup>1/</sup> There are no or insignificant amounts of area harvested, yield, and production.

<sup>2/</sup> Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.



Japan for many years was one of the largest exporters of cotton textiles. Cotton yarn exports have been minor, but exports of cotton cloth often exceeded a billion square meters annually before 1969. By 1973, Japan's cotton cloth exports had dwindled to 247 million square meters although a partial recovery occurred in 1977. Total exports of cotton products fell from 860,000 bales during 1967-69 to about 500,000 to 575,000 annually in 1972-74, with a rise to 640,000 in 1977. Japan's cotton textile exports have suffered from the impact of new or expanded cotton textile mills in South Korea, Hong Kong, Taiwan, and other developing countries, as well as a worldwide trend toward synthetics and synthetic blends (with considerable cotton content). Textile exports now account for less than 20 percent of Japan's raw cotton mill use, versus almost 30 percent in the late sixties.

Japan remains competitive in the world market for high-quality and high-technology textiles. Japanese mills have the advantage of a large domestic market to cover much of their overhead costs, and a technology level few countries can match. Nevertheless, Japan's exports of cotton goods will likely slowly decline, possibly to 500,000 bales in 1985 and less than 400,000 in 1990.

Mill Consumption and Raw Cotton Supply.--Japan is the fifth largest consumer of raw cotton, ranking after the PRC, U.S.S.R., United States, and India. It is by far the largest consumer among countries primarily depending on imports for raw cotton. Mill consumption of raw cotton rose from an average of 3.3 million bales in 1967-69 to a peak of 3.7 million in 1972, before falling to 3.1 million in 1977. This loss reflects the stress of rising costs and sharp competition from foreign competitors in both the domestic and export markets. The number of spindles at the end of 1977 was down over 7 percent from 1972. Cartels to curtail yarn output were established in 1975 and again in 1977, but were ended in June 1978 as business conditions improved.

With a strong domestic offtake of cotton textiles, and some gain in imports and some loss in exports of these products likely, mills in Japan in 1985 and 1990 could import and use over 3.7 million bales of raw cotton. Japan will thus remain the largest consumer of imported cotton.

#### Other Developed Countries

The Domestic Market.--This group of countries includes Canada, Australia, New Zealand, and South Africa. Combined domestic consumption of cotton textiles was equivalent to an annual average of 1.5 million bales of raw cotton during 1967-69, 1.9 million during 1972-74, and 1.7 million during 1975-77 (table 11). All but South Africa are among the world's largest per capita users of cotton.

Competition from Manmade Fibers.--Cotton's share of fiber consumption totaled 39 percent in 1974; 35 percent in South Africa, 43 percent in Australia, 38 percent in Canada, and 44 percent in New Zealand. All of these countries have manmade fiber industries, but Canada has the only extensive one. The others import most of their requirements. Cotton's proportion of the market has been declining very slowly, a tendency projected to continue over the projection period. Compared with recent levels, per capita consumption of cotton will be maintained and rise slightly as 1990 is approached.

Trade in Textiles.--Imports of cotton manufactures were growing rapidly until Canada and Australia drastically limited imports to preserve their domestic textile industries. Net imports reached around 1.1 million bales in 1974 and 1.2 million in 1976, but dropped under 1 million in 1975 and 1977. By 1990 a gradual rise in imports of textiles will likely be permitted, considering international trade commitments, but Canada and Australia's cotton textile industries will continue to produce at slightly above current levels.

Table 11--Other developed countries: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare			1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	26	269	32	-450	524	-546	1,097	4.92	1,960	8.95	55
1965	53	660	161	-625	730	-758	1,520	6.21	3,161	12.91	48
1970	70	500	161	-505	716	-779	1,487	5.48	3,637	13.40	41
1974	123	427	241	-426	692	-1,084	1,932	6.60	4,925	16.83	39
1975	99	435	198	-293	595	-895	1,580	5.30	NA	NA	NA
1976	96	653	288	-330	606	-1,247	1,853	6.12	NA	NA	NA
1977	122	764	428	-292	568	-995	1,553	5.02	NA	NA	NA
1985:											
Alt. I	113	698	362	-434	796	-1,496	2,292	6.22	6,740	18.30	34
Alt. II	85	698	272	-464	736	-1,378	3,114	5.74	6,219	16.88	34
1990:											
Alt. I	119	720	394	-441	835	-1,797	2,632	6.47	7,976	19.60	33
Alt. II	83	720	274	-479	751	-1,600	2,351	5.78	7,124	17.51	33

1/ Minus sign denotes net imports.  
NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

Mill Consumption.--Increased textile imports, competition from manmade fibers, rising costs, and subdued demand have distressed cotton mills in Canada, South Africa, and Australia in recent years. In Canada, mill consumption, which peaked at 430,000 bales in 1962/63, declined to less than 250,000 bales in 1974/75, and remained at this level through 1977/78. In Australia, mill consumption rose fairly steadily to 143,000 bales in 1970/71, but declined to 108,000 bales in 1977/78. In South Africa, mill consumption was highest, 295,000 bales in 1972/73, but less than 250,000 bales in 1976/77 and 1977/78. With imports restrained and some expansion in demand expected, mill consumption should not be much above 800,000 bales in 1990.

Supply of Raw Cotton.--Both Australia and South Africa produce cotton but are net importers. Canada and New Zealand depend completely on imports for cotton supplies.

Australia's cotton area has been gradually rising, but can vary considerably from year to year. The area in cotton in 1977 nearly equaled the 1972 peak of 43,000 hectares. Any considerable expansion in cotton area is unlikely, as water resources are limited and the cost of expanding irrigation is high. Yields, which have exceeded 1,000 kilograms per hectare since 1965, are already among the highest in the world, so little further expansion is anticipated.

South Africa's cotton area doubled from 1961/62 to 1967/68, and doubled again by 1974/75, when it totaled 89,000 hectares. After 2 years of reduced production, the area totaled 80,000 in 1977/78. Yields and production vary greatly from year to year because of weather, labor shortages, and high price elasticity. Production could vary less in the future as operations become more mechanized. The potential for cotton land expansion, however, is minimal, as cotton competes with tobacco and other crops.

Even with some increase in yields, production for the Other Developed region is not expected to rise enough to keep pace with higher mill consumption, and the current level of net imports will increase somewhat.

### Developing Countries

As a group, the developing countries are net exporters of raw cotton and cotton textiles. Individually, they differ greatly, ranging from being large cotton importers, such as the Far East; to being relatively self-sufficient, such as India; to being large cotton exporters, such as Turkey. Similar trade diversities exist in textiles.

#### Mexico

The Domestic Market.--Cotton textile consumption averaged 637,000 bales during 1967-69, 634,000 bales in 1972-74, but only around 600,000 bales in 1975-77 (table 12). Per capita consumption dropped from 3 kilograms in 1967 to around 2 kilograms in 1977, and is likely to stabilize at this level. With the rapid growth in population, cotton textile consumption could reach 800,000 to 900,000 bales by 1990.

Competition from Manmade Fibers.--Mexico has a large manmade fiber industry and produces practically all that is used in the country's textile industry. Imports and exports of manmade fibers are very limited. Production of noncellulosics has been rising rapidly, totaling 185,000 metric tons in 1977, and further expansion is underway. Manmade fibers have gained a rapidly rising share of the market because their easy-care properties have proved very popular, despite relatively high, protected market prices. With its large manmade fiber industry, significant oil reserves, and rising oil production, Mexico is likely to expand use of manmade fibers further. However, cotton's share of the domestic market had already fallen to 38 percent in 1976; further substitution will be more difficult and proceed more slowly.



Table 12--Mexico: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare			1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	904	506	2,099	1,612	514	17	472	2.84	630	3.80	75
1965	793	721	2,627	2,127	638	14	604	3.08	864	4.41	70
1970	422	747	1,450	994	672	47	631	2.71	1,054	4.53	60
1974	585	830	2,230	816	813	222	593	2.22	1,320	4.95	45
1975	235	836	902	660	766	161	605	2.19	1,482	5.36	41
1976	246	889	1,005	455	754	150	604	2.11	1,590	5.56	38
1977	387	900	1,600	578	712	135	577	1.94	NA	NA	NA
1985: Alt. I	399	930	1,704	654	1,050	273	777	2.01	2,219	5.74	35
Alt. II	337	930	1,440	490	950	214	736	1.90	2,104	5.44	35
1990: Alt. I	413	946	1,794	544	1,250	339	911	2.00	2,848	6.25	32
Alt. II	332	946	1,444	369	1,075	275	800	1.76	2,499	5.48	32

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.



Trade in Textiles.--Mexico imports few textiles, but exports about 20 percent of its production. Most textile exports have been cotton; rising cotton textile exports beginning around 1972, along with little change in production, have narrowed the quantity available for the domestic market. Further expansion in net cotton textile exports is anticipated, but could be limited somewhat by lack of domestic cotton supplies, and the difficulty of competing with highly efficient industries elsewhere in world markets. The volume of textile imports from the United States for final processing and return shipment will likely become important in the next decade.

Mill Consumption.--Raw cotton use rose from an average of 693,000 bales during 1967-69 to 771,000 in 1973-75, and 712,000 bales in 1977. Over the last several years, the textile industry has gradually increased its numbers of spindles and looms and it has become more modernized. With a rapidly rising population to spur the domestic market and the prospect of a moderate increase in textile exports, mill consumption of cotton could rise to 1.1 to 1.2 million bales by 1990.

Supply of Raw Cotton.--Mexico's cotton production has been extremely volatile from one year to the next, depending on relative prices for cotton and other crops (particularly winter wheat and soybeans), availability of irrigation water, and government policy. Production peaked at 2.62 million bales in 1965, declined to 1.45 million in 1970, picked up to 2.23 million in 1974, and fell off to 0.9 million bales in 1976, after which it recovered to 1.6 million in 1977.

About 90 percent of Mexico's cotton is under irrigation. Plans call for total irrigated area to rise from 5.2 million hectares in 1978 to 6.2 million by 1982, which could increase cotton area. Yields already are quite high. With greatly increased export revenue from oil now in prospect, there will not be as much pressure to raise cotton for export, while there will be continuing pressure to raise food. While future cotton production will be largely a matter of political decision, Mexico's production of cotton in 1985-90 will probably range about the same as levels in 1975-77. Thus, less raw cotton will be available for export than in the seventies.

#### Central America and Caribbean

The Domestic Market.--Consumption of cotton textiles held at around 2.1 to 2.2 kilograms per capita per year from 1967 to 1977. Little change is expected in the years ahead (table 13). Any growth will be determined primarily by growth in population.

Competition from Manmade Fibers.--Costa Rica and Guatemala produce some noncellulosic manmade fiber yarn but the countries in this region are too small to support viable, competitive manmade fiber industries. Such fibers, however, can be imported easily, and consumption has been rising rapidly. Further expansion can be expected.

Trade in Textiles.--All countries in Central America and the Caribbean but El Salvador were net importers of cotton goods in 1974. Net imports of cotton textiles ranged between 156,000 and 162,000 bales annually from 1967 to 1974. Such imports in 1985 and 1990 will likely be of about the same magnitude, depending on economic conditions in the various countries. Expanded textile exports in some of the countries are expected to offset increased imports in others.

Mill Consumption.--Most of these countries have small spinning industries. The over 350,000 spindles at the end of 1975 were mostly in El Salvador and Guatemala. Mill consumption of cotton rose fairly steadily from 132,000 bales in 1967 to 212,000 bales in 1977, and further expansion to 330,000 bales by 1985 and 450,000 by 1990 is possible. Although Central America has a large supply of raw cotton, it is questionable that a large textile export industry could be established there, when geographical and technical limitations are considered.

Table 13--Central America and Caribbean: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare	1,000 bales	1,000 bales	1,000 bales	1,000 bales	1,000 bales	Kilograms	1,000 bales	Kilograms	Percent
1960	177	548	446	367	64	-98	156	1.40	195	1.74	80
1965	387	693	1,231	1,185	110	-149	251	1.97	344	2.70	73
1970	257	745	879	809	148	-139	271	1.88	432	3.00	63
1974	413	774	1,468	1,368	202	-162	364	2.28	682	4.27	53
1975	333	831	1,271	1,264	199	-156	355	2.17	NA	NA	NA
1976	425	786	1,535	1,294	208	-161	369	2.19	NA	NA	NA
1977	493	718	1,626	1,338	212	-161	373	2.17	NA	NA	NA
1985: Alt. I	402	885	1,635	1,304	331	-180	511	2.17	1,136	4.81	45
Alt. II	364	885	1,479	1,173	306	-140	446	1.89	992	4.20	45
1990: Alt. I	411	900	1,698	1,248	450	-151	601	2.25	1,502	5.63	40
Alt. II	361	900	1,492	1,087	405	-86	491	1.84	1,226	4.59	40

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

Supply of Raw Cotton.--Central America in the quarter-century from 1950 to 1975 had one of the world's highest growth rates for raw cotton production, despite wide annual variation because of changes in cotton prices, prices of competitive crops, and weather. Guatemala and Nicaragua each account for more than one-third of the regional cotton production total, and El Salvador, one-fifth. The 1977/78 production of about 1.6 million bales slightly exceeded the previous peak in 1973/74. A large area response to price changes occurred in 1977/78 when high cotton prices induced record cotton plantings, as acreage was diverted from grains, sugar cane, and pasture. However, weather was bad, and yields were the lowest in many years.

As yields in Central America already average among the highest in the world, only a small gain can be expected in the next decade with existing technology. Another constraining factor is limited available land. Although the area in cotton has been rising in recent years, it is doubtful, based on yield and area constraints and the level of cotton prices prevailing in 1978, that future expansion could occur.

The region will likely continue to export about as much cotton in 1985 and 1990 as it did in 1977/78; thus, it will continue as one of the world's major exporters of cotton.

### Brazil

The Domestic Market.--Per capita domestic consumption of cotton textiles has sustained a level of around 3 to 3.2 kilograms annually from 1967 to 1977 (table 14). Aggregate offtake grew from 1.2 million bales to an estimated 1.7 million in 1976 and 1977. Generally in keeping with population growth, cotton textile consumption of around 2 million bales is foreseen in 1985 and 1990.

Competition from Manmade Fibers.--Brazil has a large manmade fiber industry with at least 32 plants. Production of noncellulosic manmade fibers rose from 100,000 tons in 1973 to 160,000 tons in 1977, and production capacity at the end of 1979 will total 236,000 tons. Only small quantities of manmade fibers are imported, and only if needed to manufacture end products for export. About half of the production is polyester fiber, which competes directly with cotton, but the price of polyester fiber is protected at a level of around double the price of cotton. Continued but gradual erosion of cotton's share of the domestic textiles market can be expected as the manmade fiber industry expands, because cotton's proportion of the market, about 60 percent in 1974, is still relatively high.

Trade in Textiles.--Most of the expansion in production of cotton textiles since 1969 has gone into exports. Exports have been stimulated by government incentives to promote domestic processing of Brazilian-produced raw materials to provide employment and earn more foreign exchange. Net exports of cotton manufactures rose from under 100,000 bales prior to 1972 to over 400,000 bales in 1977. With a total of about 223,000 bales in 1977, cotton yarn accounts for most of the cotton textile exports.

Exports of cotton textiles will likely continue to expand at a fairly rapid pace, although import quotas of the developed countries could moderate the expansion. Brazil can be expected to continue to be much more competitive in the world market in cotton textiles than in manmade textiles.

Mill Consumption.--Brazil's mill consumption of cotton escalated rapidly from 1.2 million bales in 1967 to 2.1 million in 1977. Exports of raw cotton have fallen to about one-fourth the levels in the early seventies, as domestic mills have taken a larger share of raw cotton production. More cotton is being shipped abroad as textiles. Brazil already has one of the world's largest textile industries, with 4.4 million spindles at the start of 1976, and expansion and modernization continue. Mill consumption could reach over 2.5 million bales in 1985 and about 3 million in 1990.



Table 14--Brazil: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare			1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	2,023	210	1,952	694	1,254	10	1,197	3.70	1,468	4.54	82
1965	2,226	244	2,499	1,277	1,277	46	1,163	3.13	1,486	4.00	78
1970	2,469	198	2,251	993	1,338	75	1,263	2.97	1,777	4.18	71
1974	2,216	229	2,340	269	1,722	294	1,428	3.01	2,386	5.02	60
1975	1,815	217	1,815	351	1,804	364	1,440	2.95	NA	NA	NA
1976	1,990	276	2,526	319	1,998	339	1,659	3.31	NA	NA	NA
1977	1,915	240	2,113	245	2,090	401	1,689	3.28	NA	NA	NA
1985: Alt. I	2,083	291	2,784	179	2,605	663	1,942	3.01	3,885	6.02	50
Alt. II	1,989	291	2,659	249	2,410	600	1,810	2.80	3,619	5.61	50
1990: Alt. I	2,104	311	3,005	5	3,000	859	2,141	2.90	4,865	6.60	44
Alt. II	1,982	311	2,832	132	2,700	792	1,908	2.59	4,336	5.88	44

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.



Supply of Raw Cotton.--About two-thirds of Brazil's cotton production is in the south; the other third is in the northeast. Cotton in the south is grown in competition with corn, sugar cane, coffee, soybeans, other crops, and pasture. Competition, particularly from soybeans, has been increasing, and the cotton crop is also vulnerable to rising labor costs. The downward trend from 1.4 million hectares in cotton in 1969/70 to under 800,000 hectares from 1975/76 through 1977/78 reflects grower dissatisfaction with returns. It is unlikely that there will be much gain in cotton area in 1985 and 1990 unless prices are much higher than in 1977/78. Yields should continue to rise gradually.

In northeast Brazil, where mostly perennial tree cotton is grown, cotton area changes little from year to year, and yields (always low) vary greatly from one season to the next, depending on rainfall. In the longer run, there is physical potential for more cotton there and in some of the central states, dependent on introduction of irrigation and more modern culture practices.

At this point, it does not appear that Brazil will grow enough cotton over the next decade to maintain high exports while also providing for its own rapidly growing mill requirements. By 1990, raw cotton exports will either be small or Brazil could become a small net importer. As a matter of government policy, Brazil could be expected to grow cotton to cover its own domestic and export textile requirements, but for the country to again be a large raw cotton exporter seems highly improbable.

#### Other South America

The Domestic Market.--Per capita consumption of cotton textiles in Other South America (South America less Brazil) varied little during 1967-77. It rose from around 2.8 kilograms during 1967-70 to around 2.9 kilograms in 1971-74, and temporarily declined to 2.6 in 1975-77 (table 15). With projected higher income, and rising raw cotton supply and mill consumption prospects, per capita consumption of cotton textiles could reach 3 to 3.3 kilograms during 1985-90. Total cotton textiles offtake, then, could be around 2 to 2.5 million bales.

The share of cotton versus manmade fibers in domestic textile consumption will continue to fall, reaching less than 50 percent. Manmade fiber productive capacity in the individual countries is small and has been expanding only slowly. Consumption of these fibers will continue to depend largely upon imports.

Trade in Textiles.--The region formerly was a slight net importer of cotton textiles, but shifted to a net exporter in 1973, mainly because of a rapid gain in Colombia's exports. The other countries are not very significant in international textile trade. Some expansion in net cotton textile exports from this region, particularly in Colombia and Peru, can be expected.

Mill Consumption.--Of the 1.4 million bales of raw cotton consumed in South America outside Brazil in 1977/78, 459,000 were consumed in Argentina, 368,000 in Colombia, 177,000 in Peru, and 170,000 in Venezuela. Mill consumption of cotton in the region has risen about 40 percent since the early sixties. In the largest producing country, Argentina, the cotton textile industry has been stagnant. Rampant inflation and a weak domestic economy discouraged expansion; only recently has mill use risen close to the 1958/59 record of 547,000 bales. Argentina's textile machinery is old, labor productivity is low, operating costs are high, and the textile industry is still operating at only 80 to 85 percent capacity. With such low efficiency, emphasis has been placed on production of textiles for the domestic market rather than for export. Manmade fibers, used in blending with cotton yarn, are relatively expensive; they constitute less than one-tenth of total mill use.

Table 15--Other South America: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare			1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	926	355	1,511	487	1,015	-59	1,089	3.15	1,525	4.40	71
1965	986	329	1,488	298	1,245	-11	1,098	2.81	1,644	4.20	67
1970	845	383	1,487	519	1,235	-12	1,247	2.83	2,107	4.78	59
1974	1,275	392	2,295	586	1,522	88	1,434	2.98	2,565	5.33	56
1975	1,029	389	1,838	962	1,337	74	1,283	2.60	NA	NA	NA
1976	1,335	376	2,304	864	1,372	74	1,298	2.58	NA	NA	NA
1977	1,583	348	2,527	1,067	1,394	78	1,316	2.56	NA	NA	NA
1985: Alt. I	1,707	416	3,261	1,211	2,050	135	1,915	3.06	4,075	6.75	47
Alt. II	1,410	416	2,694	869	1,825	108	1,717	2.74	3,653	5.83	47
1990: Alt. I	1,909	432	3,788	1,313	2,475	156	2,319	3.30	5,270	7.50	44
Alt. II	1,482	432	2,940	890	2,050	113	1,937	2.76	4,403	6.27	44

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

Expansion in both domestic consumption and exports of cotton textiles is anticipated from this region. A substantial gain is projected in mill consumption of cotton, from 1.4 million bales in 1977 to about 2 million bales by 1985 and 2.5 million by 1990.

Supply of Raw Cotton.---Production in Other South America reached a record 2.5 million bales in 1977/78. Argentina produces most of the cotton, about 35 percent; Colombia accounts for about 25 percent; Paraguay, about 15 percent; and Peru, about 12 percent.

Most Argentine cotton is grown in the far north, where the hot climate is especially well suited. Little of the cotton is irrigated. There is interest in introducing cotton in some of the drier sections of western Argentina where there are large areas of suitable land and more predictable weather, but extensive investment in irrigation systems would be required. Trends in Argentina's cotton area, yield, and production are relatively flat and disguise a high degree of yearly fluctuation. Yields have been low and area has fluctuated widely as a result of weather and relative price variability. Cotton competes for land with sunflowers and grain sorghum. The potential for some yield increase is there, with better seed, increased research, and better technical services and cultural practices. Because of high cost, fertilizer and insecticide usage has been low; neither of these inputs is subsidized, nor is government-subsidized credit available for cotton farmers. Longer staple cotton is being produced; the modal length is now between 1 and 1-1/16 inches, up from less than 1 inch a decade ago.

Colombia's cotton production has grown moderately since 1970, attaining a new peak of 684,000 bales in 1976/77. Government policy continues to encourage production for both the domestic textile industry and the export market. The government provides credit but no subsidies. Price supports have been absent since 1974, when the domestic price was allowed to rise consonant with the world price. Potentially good cotton land is abundantly available, should market conditions warrant further investment. A record cotton area of almost 400,000 hectares is estimated for 1977/78. A more rapid adoption of mechanical harvesting is predicted for Colombia than for any other South American country.

Paraguay's cotton area has vigorously expanded from a low of 34,000 hectares in 1970/71 to 300,000 hectares in 1977/78. Yields have risen less steadily than area, but a record is expected in 1977/78, and production will quadruple the level in 1972/73. Rising world cotton prices and government programs to encourage growers have created the surge in production in the seventies. Potential exists for further cotton area expansion, possibly 50 percent above the present level. However, a shortage of labor could moderate that potential. To raise yields, better seed varieties are being introduced.

Peru produces about 10 percent of the region's cotton. Output has been in decline since Peru's 1968 Agrarian Reform established collective cotton enterprises marked by poor management and lack of expertise. Cotton suffered in relation to food crop production, mainly of corn and vegetables; these could be sold freely for cash while cotton sales were regulated and crops delivered to the government. Cotton area has dropped to only 40 percent of the 1962 peak, and production is only about one-half that year's record. Yields have been irregular, but basically without trend. A limit to area expansion is the government stricture that 40 percent of the land must be devoted to food crops. Thus, additional cotton cultivation is likely to come only through gradual extension of irrigation in a country where water availabilities are limited. Except for a small quantity of medium-staple cotton, all cotton is grown in irrigated coastal valleys.



With continued high world prices, the trend in Peru's cotton area and output is likely to be reversed, yet only slowly. Yields could increase, but given the relatively high levels already attained, gains will be moderate.

Higher prices have reactivated the long-term growth of cotton production in Venezuela. Cotton output in 1977/78 is estimated to have reached 155,000 bales, compared with the previous peak of 195,000 bales in 1973/74. Venezuela possibly has more potential for increasing cotton production at a faster pace than any other major crop. Weather conditions are fairly stable. Farmers are applying more fertilizer and insecticides, and improving cultural practices. Strong production organizations are interested in investing in larger operations, in developing new areas, and in modernizing existing production techniques. Some lag presently exists in the availability of equipment and qualified personnel to mechanize operations more rapidly. The long-range goal is to produce enough cotton for self-sufficiency.

In Bolivia, cotton area is less than one-half the 1972 record. Land exists for significant expansion, but current price/cost ratios apparently do not favor expansion. Cotton exports are only one-third the 150,000 bales reached in 1973/74.

Cotton production in South America outside of Brazil has the possibility of expanding over the next 15 years more than in any other region of the world. A substantial gain in area, some gain in yield, and a production of about 3 million bales by 1985 and over 3.5 million by 1990 are very possible.

With cotton production likely to expand faster than mill consumption, Other South America should be able to expand its exports of raw cotton to around 1.2 to 1.3 million bales in 1985-90.

## Turkey

The Domestic Market.--Cotton textile consumption rose rapidly, some 37 percent from 1967 to 1977, while the population grew 21 percent (table 16). Assuming advances in per capita purchasing power and continued high rates of population growth, per capita consumption of cotton textiles should continue to rise, from 5.0 kilograms in 1977 to 5.5 to 5.6 kilograms by 1985-90. With an abundance of raw cotton and textile capacity, Turkey will have more than sufficient supplies to satisfy domestic demand.

Competition from Manmade Fibers.--Cotton's share of the textile market gradually declined from 71 percent in 1967 to 66 percent in 1974, and a further decline to less than 60 percent by 1990 is projected. Turkey produced 46,000 tons of noncellulosic manmade fibers in 1977, and it is expected to have 184,000 tons of capacity by the end of 1979.

Trade in Textiles.--Turkey's exports of cotton yarn, almost entirely to the European Community, jumped from the equivalent of 22,500 bales in 1970 to 164,000 in 1975 and to about 360,000 in 1976. Turkey supplied 35 percent of the EC's greatly expanded cotton yarn imports in 1976 versus 12 percent just 3 years earlier. Although fabric exports are increasing, their volume has been much smaller, about 28,000 bales in 1976.

Turkey enjoys preferential treatment for its cotton textile exports to the EC, but it was under pressure from EC textile interests to restrain such exports and to sell at higher prices in 1978. However, Turkey has the advantage of a large supply of raw cotton and relatively low wages. Thus, cotton textile exports no doubt will continue to rise. There probably will be a diversification in exports from being largely yarn to including fabrics and finished goods, as well as an expansion to other markets, such as Eastern Europe.



Table 16--Turkey: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare	1,000 bales	1,000 bales	1,000 bales	1,000 bales	1,000 bales	Kilograms	1,000 bales	Kilograms	Percent
1960	621	271	775	286	494	-5	497	3.93	629	4.98	79
1965	684	475	1,495	959	629	13	620	4.32	839	5.85	74
1970	526	759	1,835	1,124	837	90	747	4.59	1,072	6.59	70
1974	838	716	2,755	583	1,145	216	929	5.20	1,436	8.04	65
1975	670	716	2,205	2,163	1,215	239	976	5.32	NA	NA	NA
1976	581	819	2,185	580	1,400	468	971	5.17	NA	NA	NA
1977	777	739	2,640	1,217	1,378	429	949	4.95	NA	NA	NA
1985:											
Alt. I	877	860	3,465	1,322	2,050	754	1,296	5.46	2,196	9.25	59
Alt. II	693	860	2,739	808	1,725	548	1,177	4.96	1,995	8.40	59
1990:											
Alt. I	981	940	4,235	1,385	2,450	940	1,510	5.60	2,696	10.00	56
Alt. II	691	940	2,984	619	2,050	758	1,292	4.79	2,307	8.56	56

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

Mill Consumption.--Raw cotton use grew from about 720,000 bales in 1967 to 1.4 million in 1977. Some 3 million spindles in 1977 represent a high 130-percent increase over a 5-year period. The industry is very modern, and 56 percent of the spindles are only 1 to 4 years old. The booming textile industry has been encouraged by tax rebates, export subsidies, and other government incentives. It was estimated in 1977 that \$700 million would be invested during 1978-82 in new textile equipment, largely for weaving, knitting, finishing, and apparel manufacturing facilities, but with few additions to spinning.

Supply of Raw Cotton.--Production of raw cotton rose from some 800,000 bales in 1960 to a peak of 2.8 million bales in 1974, one of the world's most rapid expansions. Production declined in 1975 and 1976 as lower prices discouraged plantings and insect infestations reduced yields. Output recovered to 2.8 million bales in 1977, but acreage and production in 1978 have again declined because of rising costs and dissatisfaction with prices.

The Turkish Government is planning large irrigation projects in the southeast (Urfa region), where soil and climate are favorable for cotton production. These projects might take 10 to 12 years to complete, but Turkish cotton production could then reach some 4.5 million bales. Under current plans, much of the additional output would go into the manufacture of textiles, largely for export, rather than into raw cotton export.

#### Egypt and the Sudan

Egypt for many decades has been one of the world's largest producers and exporters of cotton. Almost all of its production is in the long staple or extra long staple categories. Egypt now has a large textile industry, processing most of its cotton production into fabrics mainly for domestic consumption. The Sudan produces about half as much cotton as Egypt, of which roughly half its production is extra long staple cotton and much of the remainder is upland cotton. Sudan's mill consumption of cotton is as yet limited, and the bulk of its cotton production is for export.

The Domestic Market.--Consumption of textiles in the Egypt-Sudan region has been rising under the impetus of a rapidly increasing population, some gain in the standard of living, and the expansion of the textile industry, particularly in Egypt (table 17). The latter has made possible a supply of textiles for domestic purchase, thus avoiding the outlay of foreign exchange. Cotton textile use in the two countries increased from around 700,000 bales (raw cotton equivalent) in 1967 to over a million bales in 1977. Consumption should continue to grow to reach over 1.5 million by 1990.

Competition from Manmade Fibers.--In 1978, production of manmade fibers in Egypt was limited and in the Sudan, nonexistent. There are plans in 1978 to increase production of synthetic fibers substantially in Egypt to produce synthetic-cotton blend fabrics on a large scale. Cotton's proportion of the market could drop somewhat from its present 90 percent if synthetic fibers become more available.

Trade in Textiles.--The Sudan's exports of cotton manufactures are insignificant and are not likely to be important in the near future. There are small imports of cotton fabrics. Egypt, however, has become a substantial exporter of cotton manufactures, which consist largely of cotton yarn and fabrics. In the mid-seventies, more than half the cotton yarn exports, 90 percent of the knitwear, and the bulk of the ready-made clothing went to the central plan countries. Most of the woven fabric exports, however, were shipped to the Arab countries, the United States, and Western Europe.

Expansion in exports of cotton manufactures to the U.S.S.R. and Eastern Europe may not be too promising in the next several years because of political considerations.

Table 17--Egypt and the Sudan: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare			1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	1,167	508	2,720	2,017	600	69	464	2.72	549	3.21	85
1965	1,239	552	3,143	2,145	852	220	559	2.90	665	3.45	84
1970	1,178	640	3,465	2,446	971	272	699	3.22	835	3.85	84
1974	1,107	598	3,040	1,426	1,104	187	916	3.86	1,016	4.28	90
1975	977	503	2,255	1,872	1,080	151	929	3.83	NA	NA	NA
1976	961	571	2,520	1,497	1,160	212	948	3.82	NA	NA	NA
1977	1,083	509	2,530	1,190	1,319	231	1,088	4.29	NA	NA	NA
1985:											
Alt. I	1,301	627	3,748	1,948	1,800	447	1,353	4.31	1,537	4.90	88
Alt. II	1,122	627	3,231	1,656	1,575	259	1,316	4.20	1,495	4.77	88
1990:											
Alt. I	1,505	659	4,557	2,407	2,150	575	1,575	4.42	1,853	5.20	85
Alt. II	1,202	659	3,639	1,769	1,870	323	1,547	4.34	1,820	5.11	85

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1969-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

Western Europe and the United States are gradually increasing import quotas for Egyptian textiles. The other Arab countries offer possibilities for further expansion.

In sum, net exports of cotton textiles from Egypt and the Sudan apparently were the equivalent of over 250,000 bales in 1969, 1970, and 1973, but were down to 150,000 bales in 1975 and were estimated at 231,000 in 1977. A doubling to over 400,000 bales by 1985 and further gains to nearly 600,000 by 1990 are possible. The Government of Egypt can be expected to continue to promote exports of cotton textiles as a good opportunity to earn foreign exchange.

Mill Consumption.--Raw cotton mill use in Egypt has been rising steadily, from 825,000 bales in 1967/68 to 1.3 million bales in 1977/78. In the Sudan, consumption in 1977/78 is expected to be a record 90,000 bales, compared with 60,000 to 70,000 during 1967-73. Mill consumption in the two countries could reach 1.8 million in 1985 and 2.2 million in 1990, given the pressure of rising domestic demand and the desire to increase exports of textiles.

Supply of Raw Cotton.--Egypt's cotton production declined from a record 2.5 million bales in 1969 to 1.7 million bales in 1978. Farmers, preferring to grow more profitable vegetable crops, try to minimize planting the cotton area required by the government. Only about one-third of the cotton export price is received by farmers. Rural labor shortages are a constraining factor on cotton output, and, in recent years, fertilizer and water shortages have also deterred expansion of land in cotton. Over the next decade, Egypt's cotton area could be less than the average of the last few years. Not much can be expected by way of gains in yields, barring radical changes in cotton culture.

With the prospect of a stationary or perhaps declining production of cotton and a continued rise in domestic consumption, Egypt's net exports of raw cotton can be predicted to decline. Egypt is importing more medium staple cottons for manufacture into coarse- and medium-count fabrics, which frees premium-priced long and extra long staples for export. The Sudan and the United States may supply much of Egypt's future cotton imports. A shift in Egyptian cotton exports from trade agreements with the U.S.S.R. and Eastern Europe and toward cash sales to the Far East and Western Europe has been taking place.

Planned investments in Sudan's agriculture, to be made by the Arab Authority for Agricultural Investment and Development, amount to \$5.7 billion, including funds for cotton. A 10-year program sets a production target of about 1.8 million bales by 1985, compared with 750,000 bales in 1977/78. While the goal may not be attained that rapidly, a substantial expansion in cotton production no doubt will take place.

Irrigation schemes planned for the Sudan are expected to make possible the projected cotton area expansion. Plantings may shift, however, from concentration on long and extra long staples to medium staples, and increases in yields are anticipated. Mechanical harvesting will be needed, as shortages of labor are already a problem. Almost all of the Sudan's cotton production will continue to be exported.

#### High-Income North Africa and Middle East

The Domestic Market.--For countries included, see appendix. Rising per capita incomes, urbanization, and population growth make the region a buoyant market for cotton textiles. Per capita consumption has steadily risen in the seventies, a trend that should continue through 1990. Levels will approach 4 kilograms from a low of about 2.3 in 1974 (table 18). Net imports of cotton textiles could exceed 1 million bales by 1990 from less than 300,000 in 1974. Manmade fiber consumption will grow more rapidly than that of cotton. Production of noncellulosics has been accelerating since the mid-seventies.



Mill Consumption.--Mill use of raw cotton has increased almost 50 percent thus far in the seventies, mainly in Iran and Iraq. Iran's textile industry is absorbing an increasing proportion of raw cotton supply, leaving less fiber for export. Iran's raw cotton exports have been generally above 400,000 bales a year in the past decade, mostly destined for East Europe and Asia.

Supply of Raw Cotton.--Iran accounts for about three-fourths of the region's cotton area and close to 70 percent of production. Hectares in cotton now total about 25 percent less than in the early sixties, but production has almost doubled as a result of large yield increases. About 70 percent of Iran's cotton area is under irrigation. Competition for land and water resources is strong among cotton and soybeans, wheat, and other food crops. Increasingly, Iran is experiencing difficulties in obtaining sufficient labor for harvesting cotton. Higher productivity in cotton growing is possible, but area can be extended only by sacrificing food and feed crops.

Israel's cotton area, generally increased, remains small, about 12 percent of the region's total, and cotton competes closely with wheat for additional area. Yields stabilized at a high of over 1 metric ton per hectare in the past decade. In Iraq, cotton area is a little larger than Israel's but yields are low, less than 250 kilograms a hectare.

Overall, little additional land will likely be planted to cotton in the region. Barring any radical gains in yields, production in 1990 may not be much more than 1.4 million bales, compared with 1.2 million in 1977.

#### Low-Income North Africa and Middle East

The Domestic Market.--For countries included, see appendix. Per capita cotton textile use, low at 1.8 kilograms, could dip slightly by 1985-90 in favor of manmades (table 19). Thus, cotton's market share will likely decline to 35-40 percent from about 43 percent in 1974. Total fiber use per capita is projected to rise only marginally.

Cotton textile output could rise faster than domestic market use so that the region could be a small net exporter of about 50,000-100,000 bales by 1990. In Syria, where ginned cotton and textiles were the leading industry and export earner until overtaken by petroleum in 1974, nine large textile projects are underway or projected that are expected to raise the percentage of domestic consumption of ginned cotton from less than 25 percent to 40 percent. Syria produces no manmade fibers and imports the rayon and synthetic fibers used in textile manufacturing.

Mill Consumption.--Mill use of raw cotton could double by 1990 as more of the region's cotton output, primarily Syrian, is diverted for domestic ginning.

Supply of Raw Cotton.--Syria leads in regional cotton production, turning out about 90 percent. Syria's cotton area is about 30 percent less than in 1968, as area has been diverted to sugarbeets, fruits, vegetables, and oilseeds. However, yields have risen appreciably. About 95 percent of the country's cotton area is irrigated and average yields are among the world's highest. The Syrian Government has been seeking to double-crop on irrigated cotton land, but a suitable second crop has yet to be found.

The current 5-year plan to 1980 calls for stabilizing cotton production, with area drawn back slightly in favor of other crops. However, several irrigation projects in the Euphrates Basin are planned for completion by 1980. These would provide water for an additional 640,000 hectares, doubling Syria's irrigated area and strongly raising the prospects of sizable increases in cotton area.

Table 18--High-Income North Africa and Middle East: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area : harvested	Yield : : Kilograms per hectare	Production : : 1,000 hectares	Net : raw cotton : exports 1/	Mill : consumption : : 1,000 bales	Net : cotton : textile : exports 1/	Cotton : textile : use	Per capita : cotton : textile use	Total : fiber : use	Per capita : total : fiber use	Cotton's : share
									1,000 bales	Kilograms	Percent
1960	368	322	544	235	296	-129	399	1.77	692	3.06	58
1965	431	400	792	442	342	-98	451	1.74	910	3.50	50
1970	389	525	938	573	451	-221	697	2.31	1,575	5.21	44
1974	477	620	1,358	512	599	-263	939	2.76	2,070	6.08	45
1975	396	502	913	703	587	NA	NA	NA	NA	NA	NA
1976	410	556	1,047	420	632	NA	NA	NA	NA	NA	NA
1977	425	601	1,173	513	653	NA	NA	NA	NA	NA	NA
1985:											
Alt. I	432	640	1,271	269	1,002	-677	1,679	3.49	4,095	8.50	41
Alt. II	424	640	1,247	320	927	-417	1,344	2.79	3,279	6.81	41
1990:											
Alt. I	434	690	1,376	226	1,150	-1,035	2,185	3.90	5,603	10.00	39
Alt. II	424	690	1,342	307	1,035	-643	1,678	2.99	4,304	7.68	39

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

Table 19--Low-Income North Africa and Middle East: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare			1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	242	491	546	444	101	-113	204	1.52	420	3.12	49
1965	341	572	896	675	178	-131	286	1.88	591	3.89	48
1970	291	561	750	609	200	-96	275	1.57	668	3.82	41
1974	256	635	747	325	317	-73	350	1.78	818	4.17	43
1975	261	679	814	441	320	NA	NA	NA	NA	NA	NA
1976	230	767	810	708	283	NA	NA	NA	NA	NA	NA
1977	233	723	773	485	304	NA	NA	NA	NA	NA	NA
1985:											
Alt. I	253	780	907	466	441	-8	449	1.60	1,199	4.28	37
Alt. II	250	780	896	488	408	-39	447	1.60	1,176	4.20	37
1990:											
Alt. I	254	825	961	361	600	84	516	1.57	1,431	4.35	36
Alt. II	250	825	948	408	540	37	503	1.53	1,382	4.20	36

1/ Minus sign denotes net imports.  
NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.



The Syrian cotton industry is controlled by the government at all stages, and cotton is one of the leading crops receiving government assistance. Research is being conducted on higher yielding and disease-resistant hybrid cottons and on mechanical harvesting. Cotton is picked by hand at high cost, but recent government policy calls for complete mechanization of the principal farm crops, including cotton, over the next 5 years. For each of Syria's cotton growing provinces, 100 hectares of irrigated land have been set aside for mechanical cotton planting and harvesting trials.

A small amount of cotton is produced in Yemen. Area, yields, and output have risen slowly. Projects funded by the World Bank and the Kuwaiti Development Fund aim at expanding the irrigated area by 17,000 and 50,000 hectares, respectively, and part of the new lands will be cultivated in cotton. While yields are fairly high, productivity could be raised by better pest and disease control and fertilizer use. In Southern Yemen (People's Democratic Republic), cotton production expansion would have to depend on yield gains because of the scarcity of irrigated land. Morocco's cotton area, yield, and production are on a downtrend as other crops apparently yield higher returns than cotton. Morocco is a minor cotton producer, mostly long staple for export; upland cotton is imported for the domestic textile industry.

Overall, cotton production for the region is expected to increase only minimally, to possibly 1 million bales by 1990 from about 800,000 in 1977.

#### Other Africa

The Domestic Market.--For countries included, see appendix. Population growth of over 140 million by 1990 is the major force behind a projected increase of almost 1 million bales in cotton textile consumption (table 20). Per capita consumption has remained about the same since 1967, and little increase is expected by 1990. Per capita manmade fiber use in 1974 was less than 0.5 kilogram; some increase can be predicted, but of a small order. Cotton share of the textile market could drop from 73 percent to around 70 percent by 1985-90.

Cotton textile production could rise sufficiently to reduce imports somewhat, perhaps 300,000-400,000 bales by 1985-90.

Mill Consumption.--A good potential for increased raw cotton output as well as market requirements for a large and growing population are encouraging the expansion of cotton milling capacity. Raw cotton mill use could rise some 95 percent, from 1.2 million bales in 1977 to almost 2.3 million in 1990.

Supply of Raw Cotton.--Civil war and other social dislocations have significantly reduced raw cotton production in the Other Africa region from a record 3.8 million bales in 1969/70 to an estimated 3 million in 1978/79; exports fell by a similar amount, about 800,000 bales. Based on the difference between current and peak cotton area for major producers, a potential increase of at least 1 million hectares exists. By 1990, cotton area could rise over 1.5 million hectares, from 3.3 million in 1977. About 600,000 hectares of this potential cotton area would be in Uganda, where increased yields, production, and profitability for cotton producers are readily apparent. In Uganda's second 5-year plan, cotton production was to reach almost 30 percent over the 1965/66 record of 370,000 bales. Instead, production drastically fell; now it is less than 100,000 bales. Cotton area has decreased almost 60 percent from the 1971-73 high of about 1 million hectares. A key problem is the breakdown in transport systems, which disrupts the distribution of cotton seed.

In Zaire, the potential for recovery and expansion of cotton output continues to be bogged down by logistical and political problems. Cotton output is less than one-third of levels reached in the fifties. Area and yields are down and exports have ceased. There are no government support programs for cotton, and, in recent years,



Table 20--Other Africa: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area : harvested	Yield : Kilograms per hectare	Production : raw cotton	Net : exports 1/	Mill : consumption	Net : cotton textile exports 1/	Cotton : textile use	Per capita : cotton textile use	Total : fiber use	Per capita : total fiber use	Cotton's : share
					1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	2,561	159	1,865	1,594	133	-656	817	0.94	1,092	1.25	75
1965	3,268	161	2,420	1,796	395	-933	1,189	1.21	1,502	1.53	79
1970	2,605	205	3,399	2,870	762	-922	1,540	1.38	1,902	1.71	81
1974	3,416	211	3,316	1,727	1,052	-697	1,569	1.27	2,149	1.74	73
1975	3,118	181	2,590	2,223	1,047	NA	NA	NA	NA	NA	NA
1976	3,251	210	3,132	2,044	1,107	NA	NA	NA	NA	NA	NA
1977	3,306	192	2,917	1,993	1,153	NA	NA	NA	NA	NA	NA
1985:											
Alt. I	3,751	240	4,135	2,397	1,738	-407	2,145	1.27	3,064	1.82	70
Alt. II	3,413	240	3,763	2,255	1,508	-431	1,939	1.15	2,770	1.65	70
1990:											
Alt. I	4,011	257	4,735	2,477	2,258	-297	2,555	1.31	3,758	1.92	68
Alt. II	3,411	257	4,026	2,113	1,913	-336	2,249	1.15	3,307	1.69	68

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

cotton areas have been diverted to corn production, at government urging. No fertilizer is used in cotton culture, and only low quantities of pesticides. With improved transportation, trained personnel, sufficient ginning capacity, and proper economic incentives, Zaire could double the 1959 record output of about 275,000 bales.

Mozambique and Angola are struggling to recover from the tumult of recent independence from Portugal. Mozambique's cotton output is less than half the 1975 record, as commercial farmers fled the country after independence. The government is running the cotton areas as state farms and receiving foreign technical assistance. Plans call for a return to the previous peak output by 1980. In Angola, production reached over 140,000 bales in 1974/75, but fell off sharply when the cotton fields were abandoned by the Portuguese farmers. Recovery of cotton output will probably take several years.

Tanzania is one of the largest cotton producers in the Other Africa region, with an output of about 230,000 bales in 1977/78. This output is far below the national goal established in 1969/70, 600,000 bales by 1974/75. Area in cotton has remained static in the seventies but a record 375,000 hectares were cultivated in 1977/78. Yields have been quite variable. Both the national government and aid donor countries have been giving priority to food crops. Irrigated area is limited, used mainly for rice, vegetables, and sugar cane. Cotton exports reached 350,000 bales a decade ago, but are currently running at one-half to two-thirds that level as production has fallen and domestic mill consumption has increased.

Nigeria's cotton area and output are still about 25 percent below the 1969 record, but prospects for improvement look good. World Bank multi-crop projects combining food crops with cotton are doing well. Production of cotton could advance close to 900,000 bales by 1985, the highest for this region, from a 1977/78 estimated output of 30,000. A new cotton variety, a cross between American Pima and a local variety, promises a yield potential above that of Pima.

In addition to Nigeria, two other major producers in the region are making good progress in cotton production. Mali's estimated cotton output of 200,000 bales in 1977/78 is second only to that of Nigeria in the region. Mali's cotton area and yields have been rising, and output is currently about double the 1970 level. Much of this development is due to the Mali Government's support in the provision of credit, farm inputs, stable prices, and the introduction of hardy American cotton varieties adapted for local conditions. In the Ivory Coast, cotton area has been increasing fairly steadily in the seventies. Ivorian cotton output of 175,000 bales in 1977/78 is triple the 1970/71 level.

Kenya's cotton production has been static and low the last several years. Various government projects, such as the Tana River irrigation scheme, promise to raise cotton output, but the target of 80,000 bales before 1980 will not be met. Cotton competes with corn for land and labor; corn output has been rising as its price/cost ratio is apparently more favorable. Kenya started importing cotton in the seventies, eliminating exports, to supply a growing textile industry.

In Senegal, cotton production of over 60,000 bales is about triple the 1970 level, but both output and area in cotton have been stable the past three seasons. Ghana produces a small amount of cotton which is one-third of domestic mill use. A government campaign for self-sufficiency seems far from being fulfilled.

## Pakistan

The Domestic Market.--Per capita consumption of cotton textiles in Pakistan declined below 4 kilograms in 1967-77 (table 21). With more stable domestic political conditions and rising cotton output and textiles production, use could recover to around 4.5 kilograms by 1985-90.

Table 21--Pakistan: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare	1,000 bales					Kilograms	1,000 bales	Kilograms	Percent
1960	1,312	232	1,396	238	1,116	204	854	4.07	898	4.28	95
1965	1,568	266	1,915	482	1,304	293	990	4.10	1,094	4.53	90
1970	1,748	311	2,499	468	2,030	759	985	3.54	1,123	4.03	88
1974	2,032	312	2,912	1,061	2,172	718	1,563	4.99	1,753	5.60	89
1975	1,862	276	2,361	418	2,177	NA	NA	NA	NA	NA	NA
1976	1,862	224	1,920	60	1,800	NA	NA	NA	NA	NA	NA
1977	1,775	295	2,402	386	1,901	NA	NA	NA	NA	NA	NA
1985: Alt. I	1,967	342	3,089	384	2,705	622	2,083	4.68	2,450	5.50	85
Alt. II	1,848	342	2,902	400	2,502	628	1,874	4.21	2,205	4.95	85
1990: Alt. I	2,014	358	3,312	262	3,050	671	2,379	4.59	2,901	5.60	82
Alt. II	1,844	358	3,032	287	2,745	604	2,141	4.13	2,609	5.04	82

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.



Competition from Manmade Fibers.--Pakistan's manmade fiber production is very limited and imports are small. Some gradual reduction in the heavy reliance on cotton textiles is expected, however, possibly to a level of about 85 percent by 1985 from an estimated 88-89 percent in 1977.

Mill Consumption.--Denationalization of Pakistan's cotton gins in 1977 is expected to help reverse a recent slump in cotton mill use. Any additions to raw cotton supply will likely be used in domestic cotton mills. Should cotton production projections materialize, a 60-percent gain in cotton textile consumption may be predicted between 1977 and 1990, from about 1.9 million bales to over 3 million.

Supply of Raw Cotton.--Cotton production in Pakistan has fallen in recent years. Area in 1977/78 was down 10 percent from the 1974 high, and yields were about 20 percent less than the 1971/72 record. However, measures are being taken to raise cotton output beyond past achievements. For the first time, a government-guaranteed purchase price for seed cotton has been established. Also, costs of spraying equipment and pesticides are to be subsidized and pesticides are sold on a deferred-payment basis. An FAO/World Bank mission in Pakistan in 1977 was designed to assist in an integrated cotton development project, and, subsequently, an FAO cotton productivity mission was arranged to help raise cotton yields. Pakistan has good potential for increases in yield, now among the world's lowest for irrigated cotton production. An aggressive "Grow More Cotton" campaign is being well publicized and supported by expanded agricultural extension services.

The Tarbala Dam, expected to be in operation around 1980, is scheduled to provide an additional million hectares in irrigated area, part of which will be used for cotton.

## India

The Domestic Market.--Per capita consumption of all textiles has stagnated at about 2.2 kilograms in the decade since 1967, with cotton textile use declining a bit. Further moderate decline in per capita use will likely continue, given the projected 38-percent population rise to 874 million by 1990 and the slow advance of the raw fiber and textile industries. With the decrease in per capita cotton textile use, total textile use could edge down to an estimated 2 kilograms in 1985-90 (table 22).

Competition from Manmade Fibers.--India in the past has relied almost completely on cotton as a clothing fiber. Wool consumption is small. The production of rayon has been gradually rising, and, based on the 5-year plan, could reach 191,000 tons in 1982/83, compared with 116,000 tons in 1977. Production of synthetic fibers remains small, 47,200 tons in 1977, but will reach 100,000 tons in 1982/83 if the 5-year plan is realized. Polyester consumption is as yet limited, held down by heavy taxes.

Through 1990, primary reliance will continue to be placed on cotton but the share taken by manmade fibers will gradually rise. The 5-year plan envisions that cotton will be used for 84 percent of needs in 1982/83, compared with nearly 90 percent in 1974.

Trade in Textiles.--India is one of the major exporters of cotton textiles in the world, but these exports are only a small percentage of output because of a huge domestic demand. India has the advantage of very low wages, but mill efficiency is below that of some of the other world suppliers. A rising proportion of exports consists of handloomed products. Still, cotton textile exports have been generally rising, and moderate gains by 1985 and 1990 appear likely.

Mill Consumption.--The number of cotton spinning spindles has been gradually rising, from 15.4 million in 1965 to almost 20 million in 1978. The sixth 5-year plan



Table 22--India: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare	1,000 bales	1,000 bales	1,000 bales	1,000 bales	1,000 bales	Kilograms	1,000 bales	Kilograms	Percent
1960	7,677	131	4,630	-680	4,611	425	4,003	1.96	4,369	2.14	92
1965	7,932	126	4,602	-317	5,002	542	4,734	2.09	5,207	2.30	91
1970	7,689	124	4,400	-508	5,375	593	4,782	1.90	5,650	2.24	85
1974	7,608	171	6,000	21	6,012	682	5,330	1.94	5,976	2.18	89
1975	7,446	155	5,300	130	6,050	554	5,496	1.96	NA	NA	NA
1976	6,895	148	4,685	-745	5,926	908	5,018	1.76	NA	NA	NA
1977	7,446	156	5,348	-278	5,585	708	4,877	1.67	NA	NA	NA
1985:											
Alt. I	7,411	182	6,195	-618	6,813	681	6,132	1.71	7,214	2.00	85
Alt. II	7,306	182	6,107	-196	6,303	783	5,520	1.54	6,494	1.81	85
1990:											
Alt. I	7,435	194	6,625	-686	7,311	840	6,471	1.61	7,862	1.97	82
Alt. II	7,298	194	6,502	-77	6,579	756	5,823	1.45	7,101	1.77	82

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

allows substantial expansion to provide yarn for the handlooms and power looms outside of textile mills. From 5.3 million bales in 1967, raw cotton use rose to an average of 5.7 million bales during 1976-78. By 1990, a 28-percent increase to around 7.3 million bales is projected.

Supply of Raw Cotton.--India has by far the largest area in cotton of any country in the world, but yields are among the lowest. Cotton area has declined slightly in recent years, and it could fall to 7.4 million hectares in 1985-90, compared with 7.5 million in 1978. However, yields are trending upward as a result of increased irrigation, better varieties, and more fertilizer. With almost unlimited scope for further gains, yields should continue to rise in the years ahead.

Production is projected to continue to fall short of requirements by an estimated 600,000 to 700,000 bales in 1985-90. India is not now faced with difficulties regarding foreign exchange as severe as once existed. The question remains of whether India will choose to replace imports of cotton with manmade fibers as it did in 1977.

#### Far East

The Domestic Market.--For countries included, see appendix. Per capita consumption of cotton textiles rose slightly between 1967 and 1977, from around 1.2 kilograms to about 1.35. Per capita total fiber use will continue to rise, but cotton's share can be expected to decline from around 60 to 50 percent by 1990 (table 23). This loss will restrain per capita growth in cotton consumption. Yet a projected population growth of over 200 million between 1977 and 1990 will considerably expand the market for cotton goods, which could reach an estimated 3.6 million bales in 1985 and 4.4 million in 1990.

Competition from Manmade Fibers.--Rapid and sizable expansions in the synthetic fiber industry have taken place thus far in the seventies in Taiwan and South Korea. Indonesia, the Philippines, and Thailand have smaller manmade fiber industries that also have been expanding. Until recently, their use of manmade fiber was extremely limited; however, domestic demand for easy-care fabrics is strong and consumption of synthetics can be expected to rise rapidly in the eighties.

Trade in Textiles.--The Far East represents the most rapidly expanding region in exports of textiles in the world. Net exports of cotton manufactures exceeded 500,000 bales in 1971, reached 1 million in 1975, and about 1.5 million in 1976 and 1977. Most but not all exports are to developed countries. With low wages and modern, efficient mills, some of these countries clearly are highly competitive in world trade. The major deterrent to continued expansion in textile exports will be import restrictions imposed by the developed countries to protect their own industries. If the international Multifiber Agreement continues to be effective, such restrictions will generally be relaxed year by year to provide moderate import gains. Net exports of cotton manufactures can, thus, be projected to increase about a million bales by 1990; to over 3 million bales.

Mill Consumption.--Mill consumption of raw cotton more than doubled over 1967-77, from 2.1 million bales to 4.5 million. South Korea accounts for the largest share; its 1.2 million bales consumed are about 25 percent of the regional total. Korea's fourth 5-year plan calls for an expansion to 1.5 million by 1981, with an increase in the number of spindles from 2.58 million in July 1977 to 3.28 million in 1981.

Taiwan's cotton textile industry is struggling to overcome heavy debts, and many mills are merging. Of approximately 120 cotton textile mills, some 60 percent have fewer than 20,000 spindles, which hampers efficiency. Still, cotton mill consumption is rising again after plateauing at about 700,000 bales in the early seventies, and it could reach 1.0 million bales in 1977/78. Taiwan's textile output is largely

Table 23--Far East: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare			1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	348	158	253	-1,065	1,346	-589	1,703	1.19	2,133	1.49	80
1965	406	167	312	-1,419	1,768	-314	1,982	1.21	2,604	1.59	76
1970	295	222	301	-2,640	2,701	399	2,302	1.24	3,545	1.91	65
1974	376	195	337	-2,980	3,526	895	2,631	1.29	4,199	2.06	63
1975	361	213	353	-3,638	3,848	1,038	2,810	1.35	NA	NA	NA
1976	385	289	511	-3,847	4,383	1,572	2,811	1.32	NA	NA	NA
1977	372	268	458	-4,268	4,487	1,498	2,989	1.37	NA	NA	NA
1985: Alt. I	356	313	512	-5,669	6,181	2,571	3,610	1.32	7,034	2.56	51
Alt. II	322	313	463	-5,225	5,688	2,371	3,317	1.21	6,464	2.35	51
1990: Alt. I	364	344	575	-7,020	7,525	3,123	4,402	1.41	8,839	2.82	50
Alt. II	320	344	505	-6,146	6,651	2,822	3,829	1.22	7,688	2.47	50

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.



exported; some shift in export demand from all manmade fiber products to all cotton and cotton blends has improved the longrun cotton outlook.

Cotton mill use in Hong Kong has risen only moderately in the last decade. Emphasis is being placed on production of high-quality apparel. With completely free entry of cotton yarn and fabrics, the spinning industry is having difficulty. However, mills have been updating their spinning and weaving facilities and Hong Kong has an advantage over other textile exporters in having large, established quotas in some of the developed countries. The present level of mill consumption will probably be maintained, but expansion seems unlikely.

The Philippine textile industry produces largely for the domestic market which is rising fairly rapidly in line with the high population growth. However, mill consumption in 1977/78 is well below the level in the early seventies because of highly competitive imports. Not much of an advance is expected in the eighties unless higher efficiency can be achieved in mill production.

Mill consumption of cotton in Indonesia has risen over 50 percent thus far in the seventies. The number of spindles more than doubled from about 600,000 in 1973/74 to over 1.2 million in 1977. By 1990, some 2 to 2.5 million spindles are a distinct possibility. Formerly substantial imports of cotton yarn and fibers have declined with the growth of domestic spinning.

Thailand's cotton mill consumption has almost doubled thus far in the seventies to nearly 570,000 bales in 1977. The number of cotton spindles now totals over a million, compared with 650,000 in 1975/76. Further expansion is likely, as textile exports are expected to rise, both to neighboring countries and to Western Europe (where a gradual expansion in allowable imports from Thailand has been provided by a recent agreement).

Bangladesh's textile mills have the capacity to spin 450,000 bales of cotton annually, but limited supplies of raw cotton and shortages of skilled labor and of electric power have kept output well under capacity. Mill consumption has remained about 200,000 bales annually. As present deterrents to increased mill use are likely to persist, raw cotton use is not likely to rise much in the eighties.

For the Far East countries as a group, rising domestic demands and increasing net exports of cotton goods are expected to carry raw cotton mill consumption to much higher levels in the eighties, from 4.5 million bales in 1977 to some 7.5 million by 1990.

Supply of Raw Cotton.--Cotton production in the region is limited, only a half-million bales annually. More than half comes from Afghanistan, where cotton area was 80,000 hectares in 1977 (down from a 1964 peak of 121,000). The rest is mostly in Thailand and Burma. Afghanistan's cotton area can expand at the expense of wheat and other crops, but this is unlikely as it would mean increased food crop imports. Additional irrigation could permit some rise in cotton area. Potential yield increases depend on restructuring of fields (currently too small for mechanical equipment), additional manure or fertilizer, insect control, and new, improved planting seeds. Very little work on varietal seed development or selection is being done.

Thailand's cotton area peaked at 107,000 hectares in 1969/70 and has been less than 75,000 since then. The fourth 5-year development plan has set a cotton self-sufficiency goal for 1981; and in early 1977, a cotton farming development committee was formed to provide technical and financial services for cotton production and marketing. This is the first time the government has directly stepped in to expand cotton farming as private investors have become wary of supporting cotton growing projects. Pest control continues to be a major deterrent to greater cotton harvests.



Production of cotton in Burma has declined in the last two decades. Cotton area is about 200,000 hectares, 20 percent less than the 1964/65 high. Yields were never very high, even at the Burmese record of 141 kilograms/hectare in 1953/54. With an estimated 80 kilograms/hectare today, Burma has among the lowest cotton yields in the world. Cotton production gains depend on a change in the institutional setup in which the government is the sole legal buyer and controls purchase prices at a level insufficiently attractive to maintain cotton production in the face of rising costs of fertilizers, pesticides, and other inputs.

South Korea had 144,000 hectares in cotton 30 years ago, but less than 10,000 hectares today as other crops have proved more profitable or desirable. Yields have increased, but not enough to offset the area decrease, and current 1977/78 production is the lowest in 30 years.

Other minor producers are Bangladesh, Indonesia, and the Philippines. Bangladesh has limited arable land, most of which is used for food production. About 10,000 hectares were planted to cotton in 1977/78 in Indonesia, and a joint U.S.-Indonesian venture is expected to add 20,000 hectares by 1982. A total of 100,000 hectares by 1982 has been optimistically targeted by the government.

In the Philippines, the government is seeking to develop cotton varieties adaptable to local conditions and to establish a more effective pest control program. Less than 5,000 hectares are planted in cotton, and the goal of 120,000 hectares by 1982 seems unattainable. Areas potentially suitable for cotton compete with tobacco which currently appears to be more profitable. Cotton yields should rise as the irrigated area, 30 percent of the total in 1967/77, is expected to increase.

For the Far East countries as a whole, net area planted in cotton has changed little, and yields rose only a modest 35 percent over the last decade. Nothing currently indicates any rapid increase in production. The region will continue to rely primarily on imports, and, given large prospective gains in mill consumption, will need over 5.6 million bales by 1985 and 7 million by 1990.

### Central Plan Countries

Even small percentage changes in cotton production and use in central plan countries can have significant global impacts. The U.S.S.R. was the world's largest producer of cotton in four of the five cotton seasons from 1974/75 to 1978/79. In recent years, it has been second only to the United States in exports. Also in recent years, the PRC has been either the second or third largest world producer of cotton. East Europe has been one of the world's largest cotton importers. In the years to come, the political decisions of these regions about cotton will be important determinants of the size of the world cotton market.

#### Union of Soviet Socialist Republics

The Domestic Market.--Cotton textile use in the Soviet Union has been steadily rising, with an average rate exceeding population growth. Cotton textile use reached 9.3 million bales in 1977 from the equivalent of around 7.4 million bales in 1967 (table 24). With the successful advances in cotton production (3) in the U.S.S.R. and cotton's still-high fiber market share, per capita cotton consumption is projected to rise moderately over the next 15 years and the national total could approach 11 million bales by 1990.

Competition from Manmade Fibers.--Cotton's proportion of fibers consumed in the Soviet Union has been declining moderately in the seventies, but still accounted for over 50 percent in 1976. Per capita consumption of cotton textiles is larger than in

Table 24--Union of Soviet Socialist Republics: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare	1,000 bales	1,000 bales	1,000 bales	1,000 bales	1,000 bales	Kilograms	1,000 bales	Kilograms	Percent
1960	2,191	676	6,802	1,001	6,301	-11	6,227	6.33	8,610	8.75	72
1965	2,428	780	8,699	1,401	7,202	50	7,982	6.53	14,903	11.74	54
1970	2,746	854	10,766	1,309	8,049	19	8,068	7.23	14,916	13.38	54
1974	2,880	924	12,217	2,926	8,890	-132	9,022	7.79	15,503	13.39	58
1975	2,924	865	11,611	3,449	8,986	-172	9,158	7.84	NA	NA	NA
1976	2,949	887	12,010	3,807	9,029	-179	9,208	7.81	NA	NA	NA
1977	2,992	925	12,713	3,720	9,075	-179	9,254	7.78	NA	NA	NA
1985: Alt. I	3,300	1,025	15,535	4,914	10,621	-48	10,669	8.27	21,773	16.87	49
Alt. II	3,300	1,025	15,535	5,932	9,603	0	9,603	7.44	19,598	15.19	49
1990: Alt. I	3,500	1,070	17,197	6,297	10,900	-113	11,013	8.16	24,473	18.13	45
Alt. II	3,500	1,070	17,197	7,388	9,859	-51	9,910	7.34	22,023	16.32	45

1/ Minus sign denotes net imports  
NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.

the United States (7.8 kilograms compared with 7.3 kilograms), but per capita consumption of manmade fiber is much less (only 4.3 kilograms compared with 19). Consumption of all fibers per capita about equals that of the European Community, but remains well below that of the United States.

The Soviet Union is rapidly expanding its manmade fiber industry. Production rose from 623,000 tons in 1970 to 1.1 million tons in 1977, and the 5-year plan calls for 1.5 million tons by 1990. Some 60 percent of the Soviet Union's current production of manmade fibers is rayon, but synthetics will be much more important by 1980. Current plans and trends point to a moderate growth in cotton textile use but a more rapid gain in manmade fibers.

Trade in Textiles.--The U.S.S.R. is almost completely a self-contained market for textiles. Imports and exports of cotton yarn and piece goods are very small compared with domestic production. There are no reasons supporting a significant change in this situation in the years ahead.

Mill Consumption.--In concert with cotton textile consumption, mill use of raw cotton has been gradually and steadily rising. Increased use of manmade fibers will cause some decline in the rate of gain, but mill consumption could rise to 10.6 million bales in 1985 and 10.9 million in 1990, compared with 9.1 million in 1977 and 7.4 million in 1967.

Supply of Raw Cotton.--Cotton production in the Soviet Union has risen very rapidly, from 9.3 million bales in 1967 to 12.7 million in 1977. This gain of almost 37 percent resulted from an area expansion of over 22 percent and a yield increase of over 12 percent. If the Soviet plan for 1980 is overfulfilled about the same extent as in recent years, production could rise to 13.8 million bales in 1980.

By 1980, an additional 495,000 hectares of new irrigated land are planned for cultivation above the 1976 level of 2.9 million hectares. However, from 1976 to 1977, cotton area rose only 43,000 hectares, and from 1977 to 1978, 41,000. Beyond 1980, area expansion in cotton would appear to be more difficult as the cotton areas in Central Asia will have exhausted the readily available water. Some additional resources may be committed to diverting some of the water from two major rivers in Siberia, but the potential cost is enormous. This long-range project apparently remains controversial. Assuming continued small annual increments, Soviet cotton would reach 3.5 million hectares by 1990 from about 3 million in 1978.

All Soviet cotton is irrigated. Yields, already among the highest in the world, have been rising because of improved technology and particularly because of increased application of nitrogen. As yields are now approaching the present state of the art, future gains are likely to be somewhat smaller. Accordingly, yields approaching 1,100 kilograms per hectare by 1990 are envisioned.

#### People's Republic of China

The Domestic Market.--Cotton represents nearly 90 percent of the PRC's total textile consumption. Cotton's share is declining gradually but, through 1990, it is expected to occupy about 80 percent of total textiles consumed. The PRC's per capita textile consumption is presently about half the world average so that a substantial market is potentially available. With its huge population, however, even a small increase in per capita use implies a large aggregate gain. Between 1974 and 1985, the PRC's population will grow about 146 million, and cotton textile consumption could reach an estimated 13.4 million bales, an increase of 17 percent from 1974 (table 25). By 1990, with an additional population of nearly 60 million, cotton textile use could reach almost 15 million bales.



Table 25--People's Republic of China: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare	1,000 bales	1,000 bales	1,000 bales	1,000 bales	1,000 bales	Kilograms	1,000 bales	Kilograms	Percent
1960	5,301	172	4,198	-198	5,199	323	4,876	1.67	5,186	1.78	94
1965	4,775	347	7,601	-501	7,900	346	7,554	2.36	8,161	2.55	93
1970	4,816	416	9,200	-400	9,000	561	8,439	2.38	9,476	2.67	89
1974	4,856	516	11,500	-500	11,900	488	11,412	3.01	12,923	3.41	88
1975	4,816	484	10,700	-650	11,250	NA	NA	NA	NA	NA	NA
1976	4,654	468	10,000	-450	11,050	NA	NA	NA	NA	NA	NA
1977	4,411	454	9,200	-1,700	11,750	NA	NA	NA	NA	NA	NA
1985: Alt. I	4,897	600	13,495	-1,334	14,829	1,459	13,370	3.03	16,305	3.70	82
Alt. II	4,897	600	13,495	-774	14,269	1,584	12,685	2.88	15,469	3.51	82
1990: Alt. I	4,897	670	15,069	-1,687	16,756	1,787	14,969	3.20	18,711	4.00	80
Alt. II	4,897	670	15,069	-244	15,313	1,839	13,474	2.88	16,842	3.60	80

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAO and estimated by FAS.



Competition from Manmade Fibers.--Although the PRC has depended on cotton for some 90 percent of its textile requirements, policy guidelines recently announced call for increased reliance on manmade fibers. Production of rayon rose from 40,000 metric tons in 1970 to 121,000 tons in 1977, while the output of noncellulosic fibers rose from 40,000 tons in 1970 to 60,000 in 1977. Most importantly, the PRC has been importing large and rapidly increasing quantities of manmade fibers. Imports rose from 119,000 tons in 1975 to 187,000 tons in 1977, motivated by the exceptionally low prices resulting from severe competition and a depressed business situation in the world manmade fiber industry.

The PRC is rapidly expanding its synthetic fibers industry as part of the expansion of its petrochemical industry. Reports state that capital construction during the next 8 years will far exceed that of the last 28. Planned output of synthetic fiber would account for 40 percent of the raw material used in the textile industry by 1985.

Textile mills are to produce more and more synthetic-cotton blended fabrics. Considering the time and capital required for petrochemical plants, however, the decline in cotton's proportion of the market will likely be gradual, perhaps to around 80 percent in 1985, compared with 88 percent in 1974.

Trade in Textiles.--In the midseventies, the PRC was exporting around half a million bales of cotton a year as textiles. With its huge labor force and low wages, the PRC has enormous potential as an exporter, but its capabilities may be limited to meet internal needs. Nevertheless, the PRC's cotton textile exports could expand significantly to around 1.8 million bales in 1990. Imports (36,000 bales in 1974) are expected to remain negligible. (Note that historical trade data are compiled from records of importing countries and may not be exhaustive.)

Mill Consumption.--The PRC already has the largest mill consumption of cotton in the world. Under pressure of domestic demand and increased textile exports, mill use should rise substantially. Estimated consumption rose from 9 million bales in 1970 to 12.2 million in 1978. A further gain to 16.8 million in 1990 appears possible.

Supply of Raw Cotton.--The cotton area in the PRC declined from a peak of 6.2 million hectares in 1956 to 4.4 million in 1977. Pressure to grow food and a low government purchase price for cotton are believed responsible. Procurement prices were raised for the 1977/78 crop, but a spring drought and other weather problems held the area down. With the continued pressure for food, area planted to cotton is unlikely to go beyond that in the early seventies.

Yields should respond, however, to increased availability of fertilizer, high cotton prices, and continued improvement of irrigation systems. About 60 percent of the cotton land is irrigated, and the percentage is rising. Concern over declining cotton production in recent years appears to have resulted in a change in government policies which should favor cotton. Thus, national yields could rise to an estimated 670 kilograms per hectare by 1990, compared with an average of about 470 kilograms during 1975-77. Cotton production would then reach about 15 million bales in 1990, compared with less than 10 million in 1977.

Thus far in the seventies, the PRC has had to import from 500,000 to 2 million bales of raw cotton annually. Raw cotton imports of this magnitude will continue to be needed in the eighties. Imports could exceed these levels if use of manmade fiber occurs at rates higher than projected or cotton production is de-emphasized.

## East Europe

The Domestic Market.--For countries included, see appendix. Per capita cotton textile consumption was generally stable at about 4.4 kilograms in the sixties, but has gradually picked up in the seventies to about 5 kilograms (table 26). This recent increasing trend is expected to continue, even though per capita consumption of manmade fiber will also be rising. By 1985-90, cotton's share of total fiber use is projected to be down to about 32 percent from 37 percent in 1974.

Competition from Manmade Fibers.--Nearly all of the countries in East Europe are substantial producers of manmade fibers, both rayon and synthetics. Production of rayon increased only moderately in recent years, from 414,000 tons in 1971 to 503,000 in 1977. No additions to capacity are underway. Production of noncellulosics more than doubled from 240,000 tons in 1971 to 529,000 tons in 1977, and capacity at the end of 1979 will be up to 660,000 tons. Domestic production of manmade fibers is supplemented by substantial imports, 125,000 tons in 1977. Cotton's proportion of the textile market declined steadily from 41 percent in 1967 to 36 percent in 1974, already a fairly low figure, and a further moderate drop is likely.

Trade in Textiles.--These countries have been net exporters of cotton textiles but the export balance has declined in recent years. Domestic demand for greater supplies has been a factor. Exports of cotton textiles will likely not rise much in the future because of lack of comparative advantage in production, and a predilection toward specializing in other high-technology industries.

Mill Consumption.--Cotton mill use has been gradually rising and, mainly because of rising internal demands for cotton textiles, is expected to total 4.5 million bales by 1990, compared with 3.4 million in 1977.

Supply of Raw Cotton.--There is only an extremely limited production of cotton in Albania, Bulgaria, Romania, and Yugoslavia, and both area and production have been declining. Based on mill requirements, imports will probably rise from 3.4 million bales in 1977/78 to about 4 million bales in 1985 and 4.4 million in 1990. The bulk of the area's cotton imports have come from the U.S.S.R.

## Other Central Plan Countries

This disparate group of countries includes North Korea, Vietnam, Cuba, Mongolia, Cambodia (Khmer Republic or Kampuchea), and Laos. Cotton data are not available for Mongolia and Laos. All the other countries for which some data are available uniformly import raw cotton. North Korea takes about 150,000 bales; Vietnam and Cuba, about 100,000 bales each; and Cambodia, around 5,000 bales.

In addition to the spartan necessities for clothing for a growing population, per capita textile use may rise by the eighties. Per capita total fiber use is estimated at 3.3 kilograms by 1990, from nearly 2 kilograms in recent years (table 27). Cotton will probably occupy a slightly lower share by 1990 compared with the current 74 percent. Per capita cotton textile consumption is estimated to rise from about 1.3 kilograms to around 2.3 kilograms by 1990.

Table 26--East Europe: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare			1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	117	256	138	-2,508	2,453	163	2,300	4.29	4,528	8.45	51
1965	95	274	119	-2,903	3,031	555	2,380	4.28	5,549	9.98	43
1970	80	288	106	-3,187	3,105	431	2,744	4.76	6,929	12.02	40
1974	70	343	110	-3,077	3,284	308	2,986	5.04	8,143	13.73	37
1975	78	359	129	-3,220	3,330	NA	NA	NA	NA	NA	NA
1976	80	350	129	-3,243	3,371	NA	NA	NA	NA	NA	NA
1977	80	375	138	-3,417	3,353	NA	NA	NA	NA	NA	NA
1985:											
Alt. I	72	362	120	-4,088	4,208	533	3,675	5.80	11,136	17.57	33
Alt. II	72	362	120	-3,573	3,693	384	3,309	5.22	10,026	15.82	33
1990:											
Alt. I	72	371	123	-4,377	4,500	453	4,047	6.23	12,647	19.46	32
Alt. II	72	371	123	-3,827	3,950	307	3,643	5.61	11,386	17.52	32

1/ Minus sign denotes net imports.

NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.



Table 27--Other Central Plan countries: Cotton supply and utilization and total fiber use, selected years, actual 1960-77, and projected 1985 and 1990

Year	Area harvested	Yield	Production	Net raw cotton exports 1/	Mill consumption	Net cotton textile exports 1/	Cotton textile use	Per capita cotton textile use	Total fiber use	Per capita total fiber use	Cotton's share
	1,000 hectares	Kilograms per hectare			1,000 bales			Kilograms	1,000 bales	Kilograms	Percent
1960	47	213	46	-142	138	-93	109	.31	164	.47	66
1965	32	219	32	-192	257	-135	308	.85	342	.94	90
1970	27	148	18	-372	377	-138	412	1.10	553	1.47	75
1974	26	154	18	-308	354	-154	877	1.30	681	1.76	74
1975	26	154	18	-349	367	NA	NA	NA	NA	NA	NA
1976	28	179	23	-367	377	NA	NA	NA	NA	NA	NA
1977	28	179	23	-367	381	NA	NA	NA	NA	NA	NA
1985:											
Alt. I	27	180	22	-639	661	-364	1,025	2.05	1,405	2.81	73
Alt. II	27	180	22	-589	611	-311	922	1.84	1,263	2.53	73
1990:											
Alt. I	27	180	22	-778	800	-504	1,304	2.31	1,837	3.26	71
Alt. II	27	180	22	-698	720	-454	1,174	2.08	1,653	2.93	71

1/ Minus sign denotes net imports.  
NA = Not available.

Sources: Cotton area, yield, production, trade and mill consumption, 1960-77 from FAS; cotton textile trade and use and total fiber use, 1960-74 from FAS, and 1975-77 estimated by FAS.



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Methods of Analysis

This study on U.S. cotton export potentials in 1985 and 1990 combines the expertise of USDA country and commodity analysts with the historical experience of the world cotton economy from 1960 to date. The analysis began with the alternative I analysis, the projections to 1985 and 1990, based on trend estimation, of all regional cotton market variables. Many of the projections were submitted to country and commodity analysts for review; their comments led to alternative estimations, adjustments of initial estimations, and point projections independent of estimated equations. A final set of accepted projection equations was thus obtained and used to project activity levels in the world cotton economy in 1985 and 1990. The alternative II analysis was derived from this set of equations. The regions for which projections were made and the countries comprising them are presented in appendix table 1.

The underlying empirical structure upon which professional expertise is imposed is quite simple. This simplicity is necessary because the long period of time between the most recently available data and the projection years precludes inclusion of numerous quantifiable variables that cannot be accurately projected. Instead, a determination of the effects of these variables and other nonquantifiable variables was left to the subjective discretion of the authors. The structure was simplified and the ceteris paribus conditions established by using the general assumptions listed in the introductory section of this report.

The numbers derived and presented are not to be interpreted as forecasts or most-likely scenarios. Every number has not been unanimously agreed upon by all persons who reviewed early drafts of this report. The numbers are projections; by definition, they are only estimates of possible outcomes based on trends and general and specific assumptions.

To establish first-round projections, an analytical model was formulated. The link among sectors of the model is the longrun equilibrium condition that world raw cotton production equals world use (end-use consumption) of mill-processed cotton textile products. This equivalency is an abstraction, as in any single year raw cotton stocks and stocks of intermediate and final products would prevent such a realization. However, in longrun equilibrium, it is assumed that desired stock levels are achieved in each region and production equals use; stocks are therefore dropped from consideration.

The world production and use projections are aggregations of many regional projections. Regional raw cotton production, net raw cotton trade, cotton mill consumption, net cotton textile trade, and cotton textile use determine world cotton supply and utilization. These variables are determined within the framework of the model.

For the use side of the market, total fiber use (use of mill-processed staple or filament which is either natural or manmade) is first determined. Total fiber use in the  $i^{\text{th}}$  region,  $TF_i$ , is assumed to depend on that region's income,  $Y_i$ , and population,  $POP_i$ :

$$(1) \quad TF_i = TF_i(Y_i, POP_i)$$

Implicitly, prices of textiles used and nontextile products consumed are assumed to exert little or no influence on total fiber use levels.

With total fiber use determined, the optimal mix of cotton and manmade textiles depends on price and nonprice factors. Cotton's share of total fiber use in the  $i^{\text{th}}$

region,  $S_i$ , is assumed to depend on the ratio of raw cotton price to manmade staple price,  $PCOT/PMM$ , and a time trend,  $T$ :

$$(2) \quad S_i = S_i(PCOT/PMM, T)$$

The relative cost of cotton and manmade textiles is assumed to be related to relative raw material costs. In the long run, this specification states that consumers, not mills, determine the proportion of the fiber market captured by cotton and manmades. Combining equations (1) and (2), world cotton use,  $WCU$ , the sum of regional uses,  $C_i$ , may be expressed as a function of price:

$$(3) \quad WCU \equiv \sum_i (TF_i)(S_i) \equiv \sum_i C_i = WCU(PCOT)$$

For the production side of the market, yield and area harvested must be determined. Yield in the  $i^{th}$  region,  $YI_i$ , is assumed to depend on a time trend:

$$(4) \quad YI_i = YI_i(T)$$

Regional area harvested,  $AH_i$ , is expressed as a function of the expected price of cotton:

$$(5) \quad AH_i = AH_i(PCOT)$$

World cotton production,  $WQ$ , the sum of regional production,  $Q_i$ , may be expressed as a function of price:

$$(6) \quad WQ \equiv \sum_i (YI_i)(AH_i) \equiv \sum_i Q_i = WQ(PCOT)$$

In global longrun equilibrium,

$$(7) \quad WCU \equiv WQ$$

With exogenous variables given, the cotton price that clears the world market may be solved for, and regional cotton use, area, and production obtained.

The link between the use and production sides of the market, through determination of regional mill consumption levels, remains to be established. Regional mill consumption,  $MC_i$ , viewed as extremely mobile globally, is assumed in the long run to continue to bear the same relationship with total world mill consumption,  $WMC$ , as in the past. That is, as total world mill consumption changes, each region increases or decreases its share of this total based on its historical share movement:

$$(8) \quad MC_i = MC_i(WMC)$$

World mill consumption in the long run is identical to use and production; hence, it, and regional mill consumption, are determined by equations (1) - (7):

$$(9) \quad WCU \equiv WQ \equiv WMC \equiv \sum_i MC_i$$

This view of regional mill consumption simply acknowledges that no simple, standardized set of explanatory variables can explain, across all regions, the diverse historical trends that have occurred since 1960.

Finally, trade balances may be derived. In the  $i^{th}$  region, net raw cotton trade,  $NCT_i$ , is the difference between production and mill consumption and net cotton textile trade;  $NTT_i$ , is the difference between mill consumption and cotton textile use:

$$(10) \quad NCT_i \equiv Q_i - MC_i$$



$$(11) \text{NTT}_i \equiv \text{MC}_i - \text{C}_i$$

In the following sections the specifics of the projection sequence will be detailed. One variable, not specified above, plays a major role, and that is judgment. Since an effort was made in this analysis to examine potential cotton use and production, the future effect of forces just being born today and those just being conceived received some weight in the projection process. In this sense, there is an element of speculation in the study. However, it is speculation aided by persons knowledgeable in cotton or the country in question, conducted in a consistent framework, and confronted with the historical trends in major cotton market variables in each region.

### Total Fiber Use

#### Data

Data are not available on actual domestic consumption of all fibers at the retail level. Domestic consumption is, therefore, approximated by using total fibers available for home use. The fiber use series consist of mill consumption plus the net textile trade balance measured in raw fiber equivalents. For statistical estimation purposes, USDA data (20) covering 1960-76 are used for the United States and FAO data (6-12) covering 1960-74 are used for the remaining regions. Supplementary data are in (13).

Income series used consist of personal consumption expenditures for developed regions and gross domestic product for the developing regions. Both series were supplied by the Foreign Demand and Competition Division (FDCD), ESCS. All income series are in 1975 prices. Domestic currencies are used for single-country regions and U.S. dollars for multiple-country regions. In the latter case, domestic currencies were converted to dollars based on 1975 exchange rates. Assumed income growth rates used to project income are based on projections of the United Nations Center for Development, Planning, Projection and Policies (CDPPP) supplied by FDCD. Income series were not used for central plan regions.

Historical population statistics are United Nations (UN) data provided by FDCD and population projections are UN medium-variant projections (1).

Not all countries are represented in aggregate data used for regional analyses because data are not available for many countries.

#### Analysis

Per capita total fiber use in developed and developing regions is expressed as a function of per capita income. Three versions of this relationship were estimated:

$$(1) \text{TF/POP} = a + b \text{Y/POP} + c \text{D}_{03}$$

$$(2) \text{Log (TF/POP)} = a + b \text{Log (Y/POP)} + c \text{D}_{03}$$

$$(3) \text{TF/POP} = a + b \text{Log (Y/POP)} + c \text{D}_{03}$$

where:

TF is total fiber use,

POP is population, and

Y is personal consumption expenditure or gross domestic product.

$D_{03}$  is a dummy variable which is 1 for 1960-63 and 0 thereafter.

Many revisions were made in the computation of the FAO fiber use data beginning in 1964; the dummy variable is included to account for these alterations.

Accepted projection equations appear in appendix table 2. Projections based on equation (1) were typically the highest, followed by those from equation (2), and projections from equation (3) were the lowest. Equation (3) is used in the analysis for each of the developed regions and equation (1) for each of the developing regions.

The decision to use these estimated versions was motivated by the current gap in per capita fiber use between developed and developing regions. Since the late sixties, manmade fiber consumption has made large gains in developed regions. These gains were based not only on fiber substitution but also on new product appeal. This latter effect may be essentially exhausted in developed regions but not in developing regions because of restraints on income, mill capacity, and manmade fiber production capacity. For developing regions, equation (1) seems most consistent with current and prospective fiber use. In addition, cross-section evidence (19) implies the response of total fiber use to changes in income declines at higher levels of income. Together with high current fiber use levels, this implication suggests equation (3) is appropriate for developed regions.

The evidence on income elasticities across regions is mixed. High and low values are observed for both developed and developing regions. Because estimated elasticities for Pakistan and India are negative and not statistically significant, this result was rejected and population was used to explain total fiber use. The variety in the magnitude of the elasticities indicates very different expenditure patterns across regions. Those patterns may be the result of textile availability, which depends on domestic production capacity, and trade restraints. Prices and availability of nontextile products, not represented in the estimated equations due to their unavailability, are also important. In addition, cultural characteristics, such as the extent to which fashion and household furnishings are important, determine income expenditures on textile use.

In central plan regions, projections are based on a simple linear trend because available income data are limited:

$$(4) \quad TF/POP = a + bT + cD_{03}$$

where:

$T$  is 1 in 1960, ..., 15 in 1974.

An additional dummy variable,  $D_{14}$ , (1 during 1960-70 and 0 thereafter) is used for the PRC to account for a very large increase in fiber use in 1971. Although no attempt was made to use an income variable in central plan regions, the trend equations provide a very good explanation of past fiber use.

Appendix tables 3, 4, and 5 present population, income, and total fiber use projections under alternative I demand. In the aggregate regions, especially Other Africa and the Far East, unavailable income and fiber use data for some countries make the per capita levels in appendix tables 3 and 4 appear lower than actual. The fiber use figures are closer to the true values, as fewer countries were omitted in the fiber use aggregation than in the income series aggregation.

Regression projections in appendix table 5 differ from those accepted for analysis in the following regions: Japan, Other South America, Turkey, Egypt and Sudan, High-Income North Africa and Middle East, Pakistan, and the PRC. For Japan, Other South

America, Turkey, High-income North Africa and Middle East, and the PRC, high-income growth rates and elasticities (or trend responses) lead to per capita use levels that appear too high, given cultural and/or political considerations. In Pakistan, Egypt, and the Sudan, cotton production potential and the depressed textile consumption levels experienced during the sample period motivated higher projected use levels. In all cases, accepted projections were based on assumed per capita use levels developed through consensus judgment.

### Cotton Use

#### Data

The cotton-use data sources and years of coverage used for estimation are the same as for total fiber use. Cotton use is defined as mill consumption plus the net cotton textile trade balance measured in raw fiber equivalents. Cotton's share in total fiber use is the ratio of cotton to total fiber use. A share calculated in this manner is acceptable for projecting total cotton use. However, it may overstate cotton use from the end product viewpoint, because (1) a given weight of raw manmade fiber can produce more square yards or pieces of textiles than the same weight of raw cotton, and (2) the FAO total fiber use series does not include all fibers consumed for all regions (such as silk and flax for pre-1964 data).

Prices were obtained from the Foreign Agriculture Service (FAS), USDA, and (20).

#### Analysis

The level of total fiber use by a region's consumers is assumed to be determined by real income. Consumers must, then, simultaneously decide on the proportions of this level of textile use that is to be composed of manmade and cotton fibers. A crucial factor in this decision is the price of manmade compared with cotton textiles.

Final cotton and manmade textile product prices are not available for most regions, so raw fiber prices are used to explain cotton's share of the fiber market. Final product prices in a region depend on raw fiber prices, wages and other mill production and finishing costs, mill-to-consumer spreads, and imported textile product prices. Although the many costs from raw fiber to final consumer influence relative purchases, the use of raw fiber prices is reasonable as many of the processing and distribution costs are the same for a textile product, irrespective of the type of raw fiber.

In determining textile proportions, then, consumers are assumed to choose an optimal mix of cotton and manmade textiles based on the expected relative price of cotton to manmade staple. For estimation, the same expected relative price is used in each region and it was taken to be the world cotton/polyester price ratio. Each price was denominated in U.S. dollars and averaged over the 2 most recent years.

Nonprice fiber characteristics, such as durability, ready to wear, and fashion contribute importantly to consumer decisions on cotton's share in end-use markets. These nonprice factors help to form consumer tastes and preferences. As these tastes and preferences respond over time, the formation process is represented by a time trend.

The estimated share equation is:

$$(5) \quad S = a + b \text{ PCM} + c \text{ LT}$$

where:



S is share of cotton in total fiber use,

PCM is the average of the ratio of the Liverpool 'A' index of SM 1-1/16" to U.S. price of 1.5 denier polyester staple for the current and the previous year, and

LT is the logarithm of 1,...,16.

This equation was selected after investigation of alternative functional forms, without included prices, for all regions and with price for the United States. Appendix table 6 presents alternative projections under three functional forms with price absent. The three forms are the S-curve (logistic), often used to explain adoption of new technology,

$$(6) \quad S = a + b/(1+cp^T)$$

semilog,

$$(7) \quad S = a + bLT$$

and linear,

$$(8) \quad S = a + bT.$$

The semilog was selected for use with a price variable for most regions because the trend-only projections are close to expectations and there were fewer parameters to estimate.

Estimated price-dependent equations appear in appendix table 7. Because it is desirable to separate the effects of the trend and price variable, which are negatively correlated, and only negative price elasticities are acceptable, based on theory, a mixed estimation technique is used (18). This technique permits stochastic constraints to be placed on the price elasticities. The constraints are based on prior information (19) in which the elasticity of demand (mill consumption) is estimated at -0.2 for developed regions and on the -0.17 ordinary least squares (OLS) estimate of the U.S. share elasticity. The prior information used in estimation consists of share elasticities (equivalent to cotton use elasticities) of -0.2 for all foreign developed regions, all Latin American regions, High- and Low-Income North Africa and the Middle East, and the Far East, and -0.1 for all other regions.

Despite use of the mixed estimation technique, some estimated elasticities were positive, so point projections were made for cotton's share in these regions. Note that the mixed technique did not change any OLS-estimated elasticities appreciably, except for Low-Income North Africa and Middle East, the only region for which the sign was reversed.

The log trend variable fits the original sample period, 1961-74, well in many cases. However, the rate of change of cotton's share is a decreasing function of time, which results in little trend effect in 1990, 16 years beyond the sample period, for some developing countries. It is likely that adoption of manmade fiber will still be taking place because of nonprice incentives (such as new domestic production capacity). The trend effect is thus enhanced by use of a subsample of the data wherein the initial observation appeared to represent a point at which a sustained takeoff in manmade fiber adoption occurred.

The viability of the regression projections was determined by examining share projections for 1985 and 1990 with PCM equal to 1.15:1, compared with the 1.35:1 averaged over 1974-76. This somewhat arbitrary level is used because it allows for manmade



fiber price increases relative to cotton price. Increases are expected to result from (1) a continuing substantial real-price rise in crude oil prices through 1990, (2) a reduction in current excess manmade fiber productive capacity which has been the source of price competition and industry losses, and (3) a continuing increase in world cotton yields, which mitigates real cotton price rises.

Regression equations used in the baseline projections are intercept adjusted to yield the accepted projected shares, under moderate demand with PCM equal to 1.15:1. These accepted shares are derived from subjective evaluation of many factors not included in the regression equations and incorporate the perceptions of country and commodity analysts (app. table 8).

The point projections and adjusted regression equations are multiplied by total fiber use and aggregated to provide a world cotton use demand equation and price elasticities of demand for 1985 and 1990. With PCM equal to 1.15:1 and world demands of 75 and 83 million bales (alternative I levels), the calculated elasticities for 1985 and 1990 are -0.078 and -0.083, respectively. The slight rise from 1985 to 1990 reflects the lessening influence of nonprice demand determinants over time.

### Global Implications for Manmade Fibers

The analysis was not designed to project market variables for manmade fiber. Yet the analysis provides some measure of the dimensions of manmade fiber production required for the industry to be compatible with the cotton market projections. Data on the sum of nonglass noncellulosic and cellulosic fiber production (16, 17) for 1967, an important period in the manmade fiber industry, and for 1976 show world production to be 7.09 million and 13.62 million metric tons, respectively. Noncotton fiber use levels, derived from cotton's share, and total fiber use projections in 1985 and 1990 are 20.37 million and 24.46 million metric tons, respectively, under alternative I and 18.92 million and 22.12 million metric tons under alternative II.

Assuming the projections are compatible with the actual historical production data, these levels, under alternative I demand, show annual average gains in manmade fiber production of 0.73 million metric tons from 1967 to 1976, 0.75 million metric tons from 1976 to 1985, and 0.82 million metric tons from 1985 to 1990. Although rising absolutely, annual average percentage gains over these periods are declining at 7.5, 4.7, and 3.8 percent, respectively. Under alternative II, the average annual gain over 1976-85 is 0.59 million metric tons, and over 1985-90, 0.64 million metric tons. This reduced growth implies annual average growth rates of 3.7 and 3.2 percent over the two projection periods.

### Mill Consumption

#### Data

The mill consumption data set used in this analysis covers the years 1960-76 and was obtained from FAS data tapes. The series has also been published (21 and 22).

#### Analysis

With cotton textile use levels projected in each region (hence, world use projected), the degree of a region's self sufficiency in use must be determined. Cotton spindles and looms are highly mobile resources; their geographical distribution has changed considerably over the past two decades. The distribution is sensitive to numerous forces (such as labor supply, wage rates, and government policy), which, even if capable of being quantified and used to explain past trends, cannot be projected with any degree of confidence. For this reason, statistical relationships devoid of

explanatory variables with economic interpretation are used to provide a first, or trend, approximation of mill consumption levels.

Historical trends in mill use shares in each region are determined through estimation of a relation of the following form:

$$(9) \quad MC_i = a + b \text{ MCW}$$

where:

$MC_i$  is mill consumption of cotton in the  $i^{\text{th}}$  region, and

MCW is world mill consumption of cotton.

This equation quantifies the way in which a region's mill consumption changes as the volume of total world mill consumption changes. Effectively, it determines a region's share of world cotton spindles and looms. It was useful in the analysis for two reasons. Projected cotton textile use levels for 1985 and 1990 may be directly substituted in the right-hand side of the equation, which provides regional mill consumption projections. As a byproduct of OLS estimation, the sum, across all regions, of the coefficients on MCW equals 1 so that changes in MCW will be completely apportioned across all regions.

The estimated equations appear in appendix table 9. Since MCW has been rising over time, the size of each region's coefficient on MCW indicates the extent to which mill resources came into or left the region during the sample period. The largest rates of increase in mill use occurred in the PRC, the Far East, and the U.S.S.R. The largest declines occurred in the EC and the United States.

Although these rates of change reflect the historical experience, the structural conditions (characteristically highly changeable) under which they emerged are not expected to obtain through 1990 in all regions. Thus, some regression projections were revised and accepted mill consumption levels, based on judgment, were used for the analysis. The accepted projections represent a moderate approach. Accepted mill use levels in the fastest-growing regions were usually reduced from regression projections, and levels in the fastest-declining regions were increased over regression projections. Higher-than-regression projections were accepted for many developing countries, based on a continuing shift in mill production capacity that favors low-wage regions with cotton production potential and strong economic development prospects. Regression and accepted projections, under the alternative I demand, appear in appendix table 10.

### Cotton Production

#### Data

Cotton area, yield, and production data were obtained from FAS data tapes. They cover the 1960-76 crop years and include preliminary 1977 data. The price data cover 1959-76 and were obtained from FAS and (20).

#### Analysis of Yield

Major differences exist across regions of the world, both in actual observed annual yields and in expected trend yields. The dominant factors that cause deviations from expected trend yields are weather variables, changes in quantity and timing of rainfall, and temperature levels. Moreover, annual changes in the expected profitability of growing cotton can cause yield deviations from trend as these changes lead

to more or less intensive input use. Changes in profitability also lead to expansion or contraction of area, which affects yield by bringing more or less productive land into cotton production. As analysis of the year-to-year changes in yields requires extensive country-specific climatological and economic data not available and because the emphasis of the study is on underlying trends, annual yield deviations were not analyzed. For such an analysis for the United States, see (5).

Differences across regions in trend levels of yield, the focus here, may be traced to a number of factors. Natural climate, soil quality, level of irrigation, farm size, farm traditions, and input quality and availability are some determinants. Two of the most important which, over time, may be most responsible for fundamental increases in yield are irrigation and input characteristics. The latter covers such diverse items as seed and pesticide quality and fertilizer availability. The development of both irrigation facilities and input production and delivery systems depends on the level of agricultural development. This slowly changing process was, for this analysis, assumed to be captured through regression of yield on time trend. Factors responsible for annual deviations, primarily weather, are assumed captured in the regression's standard error.

Three yield equations were estimated for each region:

$$(10) Y = a + b T$$

$$(11) Y = a + b L T$$

$$(12) Y = a + b T + c T^2$$

where:

T is 1 in 1960,...,18 in 1977, and

LT is the logarithm of T.

Projections from the three versions were examined in light of (1) potentials for general economic development, agricultural development, and adoption of specific technologies, and (2) stated national objectives for cotton production. Based on these factors, one of the three above equations was selected as best representing a region's potential; if none were satisfactory, alternative yield projections were specified.

The accepted yield projections appear in appendix table 11. Regression projections based on equation (10) are also presented, for comparison purposes. In several cases, accepted projections are below the linear trend projections, which reflects already high levels of agricultural development, irrigation, input use, and the belief that no major technological breakthroughs in the near future are expected (multi-adversity seed varieties, for example).

Although irrigation levels could not be ascertained for all areas, information on regional percentages of total cotton area irrigated, for 1975, that did contribute to establishing accepted yields includes: United States, 32; Other Western Europe, 95; Australia, 95; Mexico, 90; Central America and Caribbean, 0; Brazil, 0; Colombia, 15; Argentina, 10; Peru, 98; Turkey, 77; Egypt, 100; Sudan, 83; Algeria, 65; Iran, 70; Israel, 89; Morocco, 100; Syria 89; Pakistan, 95; India, 18; and the U.S.S.R., 100.

#### Analysis of Area

Although certain regions have experienced continued increases or decreases in cotton area harvested, world area harvested over 1960-76 has been fairly stable. In



fact, both the maximum and minimum levels have occurred thus far in the seventies as 33.5 million hectares harvested in 1972 and 29.8 million hectares in 1975.

In projecting potential regional cotton area, the observed world stability in area was noted and only a few fundamental trends in area, not related to price, were considered. For all regions, a base or stable area was selected, along with a compatible base cotton price. Any changes in this area to 1985 and 1990 result only from base price changes effected through a longrun area response elasticity. Area response equations, then, were constructed as follows:

$$(13) A = AB + E_L AB((P-PB)/PB)$$

where:

A, AB are harvested and base harvested areas,

P, PB are cotton price and base price, and

$E_L$  is longrun area response elasticity with respect to price.

Base areas for most regions are the 1972/73-1977/78 average area harvested; base price, using the 1971/72-1976/77 period, for all regions is 68 cents/pound, the crop year Liverpool 'A' index deflated by the U.S. producer price index in 1975 dollars. Elasticities used are mostly estimated values with two assumed values.

The results of elasticity estimation are presented in appendix table 12. Cotton farmers in each region are assumed to base planting strategy on expected farm price (15). Empirically, this may be expressed as

$$(14) A = a + B PL + c AL$$

where:

PL is previous season's Liverpool 'A' index deflated to 1975 U.S. dollars by U.S. producer price index, and

AL is previous season's harvested area.

This specification, reflecting paucity of data, has several limitations. It assumes profitability of cotton is related to cotton price and that of other crops is related to the U.S. producer price index. Also, it assumes relative profitability in foreign regions is determined by a world cotton price and the U.S. producer price index. Nevertheless, estimation results are generally plausible.

Most elasticities are consistent with expectations. In developed regions for which information and technology (factors which induce and permit flexibility) are readily available, higher elasticities are expected. For the United States, no estimation was conducted; here, area response is based on (5) in which the U.S. longrun elasticity was estimated at 1.71. In Latin America, higher elasticities are expected for Mexico, Central America and Caribbean, and for Other South America where government intervention is generally limited and good crop alternatives exist. In Brazil, these factors prevail to a lesser extent, so a lower elasticity is expected. Here, a trend variable is included in the estimation to capture the strong decline in area in southern Brazil due to better crop alternatives. For the other developing regions, information and technology constraints, custom, crop alternatives, and government policy are all expected to reduce regional responsiveness to changes in world price. In the central plan regions, zero elasticities are expected based on the absence of a clear relationship between internal and world prices.



Mixed estimation was used in the area response estimation in some regions. When OLS estimated shortrun and longrun elasticities were at great variance with prior estimates, stochastic restrictions, using information in (14 and 19), were imposed.

Accepted base areas and price elasticities for the alternative I demand analysis are presented in appendix table 13. For Other South America, Turkey, Egypt and Sudan, and Pakistan, changing economic situations, irrigation projects, and national plans emphasizing cotton motivate increases in base areas. In Other Africa and the PRC, base area is related to past peak area harvested. In East Europe, base areas are projected from a regression equation containing the logarithm of time trend only. In the U.S.S.R., base areas are assumed. Accepted elasticities are the same as those estimated in all regions except for Low-income North Africa and Middle East and Other Africa in which small responses, 0.1, are assumed.

When area response equations, each of the form of equation (14), are constructed for each region, multiplied by yield, and aggregated, a world supply response equation results. World supply response elasticities calculated from such as equation, with a price of 68 cents/pound and alternative I supplies of 75 and 33 million bales, are 0.48 for 1985 and 0.45 for 1990.

### Alternative II--Lower Cotton Use

#### Analysis

The conditions assumed to prevail under alternative II are based on conditions underlying the alternative I analysis. On the demand side of the world market, alternative II was established by reducing projections for total fiber use and leaving share projections intact. Alternative II income growth rates are the alternative I rates reduced by 25 percent. These lowered income projections are used to project levels of reduced total fiber use in all regions except Japan, Other South America, Turkey, Egypt and Sudan, High-income North Africa and Middle East, Pakistan, and the PRC. In these regions, the alternative II total fiber use regression projections are made acceptable by multiplying them by the ratio of the accepted-to-regression projections determined in the alternative I analysis. Hence, the alternative II adjustment is proportionally the same as that in alternative I. For India and the central plan regions, alternative I total fiber projections are reduced by 10 percent.

On the supply side of the world market, some of the point projections used to determine base areas harvested in each region, under alternative I, were chosen on the presumption of the strong world demand reflected in past trends. Restricting demand-side growth necessitates a respecification of base area projections in affected regions. Consequently, alternative I base area projections in the developing areas of Other South America, Turkey, Egypt and Sudan, Other Africa, and Pakistan are reduced. Alternative II base areas in the central plan regions are the same as under alternative I, except the PRC's which is lowered slightly.

In Other South America and Egypt and Sudan, even under more restrictive world demand, there could be incentives to expand cotton area. For each of these two regions, lower use area projections are slight reductions from alternative I base areas.

Base areas in Turkey, Other Africa, Pakistan, and the PRC for 1985 and 1990 are taken to be the average area harvested over 1971-76.

Although a case can be made for altering yields under lower world cotton use, alternative I yield assumptions are retained. Accepted income growth rates and base areas appear in appendix table 14.

Mill consumption levels are projected by use of each region's share of world mill consumption originally projected under alternative I. Some of these projections were altered to reflect changes in base areas, more believable trade balances, or judgement. Projected and accepted levels are presented in appendix table 15.

A different approach to establishing a lower use alternative would be to retain the alternative I income growth and total fiber use levels and increase the projected rate of decline in cotton's share of total fiber use. Appendix table 16 presents a set of base shares that, using Alternative I total fiber use levels, results in the identical alternative II cotton market solution as the one obtained by reducing the alternative I income growth and total fiber use levels. The only difference between the two analyses lies in the implications for manmade fiber consumption.

# Appendix table 1--Regions and their country detail

## United States

### Foreign Developed

European Community (EC)

Belgium-Luxembourg, Denmark, France, West Germany, Ireland, Italy, Netherlands, and United Kingdom.

Other West Europe (OWE)

Austria, Finland, Norway, Portugal, Spain, Sweden, Switzerland, Greece, Iceland, and Malta.

Japan

Other developed (OD)

Canada, Australia, South Africa, and New Zealand.

### Developing

Mexico

Central America and Caribbean (CAC)

El Salvador, Guatemala, Honduras, Nicaragua, Costa Rica, Dominican Republic, Panama, Haiti, and Leeward-Windward Islands.

Brazil

Other South America (OSA)

Argentina, Bolivia, Colombia, Paraguay, Peru, Chile, Ecuador, Uruguay, Venezuela, Guiana, and Surinam.

Turkey

Egypt and Sudan (EGSU)

High-income North Africa and Middle East (High)

Algeria, Cyprus, Iran, Iraq, Israel, Saudi Arabia, and Libya.

Low-income North Africa and Middle East (Low)

Lebanon, Morocco, Syria, Tunisia, Yemen, Southern Yemen, and Jordan.

Other Africa (OA)

Angola, Benin, Cameroon, Central African Republic, Chad, Ivory Coast, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Rhodesia, Senegal, Tanzania, Togo, Uganda, Upper Volta, Zaire, Zambia, Ethiopia, Ghana, Liberia, Malagasy, Somali, Reunion, Rwanda, Mauritas, Seychelles, Cape Verde Islands, Mauritania, Guinea Bissau, Sierra Leone, Gabon, Sao Tome and Principe, Congo, Camoro Islands, Afars, and Issas.

Pakistan

India

Far East

Bangladesh, Burma, Sri Lanka, Indonesia, Malaysia, Philippines, Thailand, Hong Kong, South Korea, Taiwan, Singapore, Afghanistan, Nepal, Brunei, Timor, Solomon Islands, Fiji, and New Guinea.

### Central Plan

Soviet Union (U.S.S.R.)

Peoples Republic of China (PRC)

East Europe

Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and Yugoslavia.

Other central plan (OCP)

North Korea, North and South Vietnam, Cuba, Mongolia, Khmer, and Laos.

Appendix table 2--Estimated per capita total fiber use equations

Region	Independent variables <u>1/</u>						R <sup>2</sup>	Income elasticity <u>3/</u>
	Constant	Y/POP <u>2/</u>	POP	T	D <sub>03</sub>	D <sub>14</sub>		
United States	-199.44	26.68 (12.41)					0.91	1.24
Foreign developed:								
EC	-52.26	8.67 (6.40)			-1.49 (-1.01)		.91	.68
OWE	-70.37	10.71 (10.52)			.54 (1.21)		.95	1.08
Japan	-114.06	9.66 (4.66)			2.44 (1.72)		.73	.75
OD	-103.06	15.19 (9.16)			-1.73 (-4.07)		.97	1.21
Developing:								
Mexico	2.10	1.72 (5.60)			-1.17 (-1.18)		.92	.52
CAC	-.18	1.02 (8.27)			-.59 (-4.04)		.94	1.12
Brazil	3.22	2.08 (7.32)			.46 (4.64)		.83	.24
OSA	.35	4.87 (4.30)			.17 (.73)		.68	.91
Turkey	3.25	3.84 (5.58)			-.74 (-3.15)		.90	.51
Egypt and Sudan	3.14	2.65 (.36)			-.39 (-1.74)		.40	.20
High	.66	1.75 (6.06)			-.26 (-.79)		.87	.86
Low	3.59	2.02 (.79)			-.80 (-5.80)		.82	.11
OA	.37	4.40 (5.63)			-.05 (-.86)		.93	.76
Pakistan <u>4/</u>	-61.45		5.41 (3.10)		33.16 (1.21)		.70	
India <u>4/</u>	344.67		1.57 (4.77)		-19.49 (-.55)		.84	
Far East	.90	6.21 (2.98)			-.17 (-1.24)		.70	.49
Central plan:								
U.S.S.R.	10.30			.25 (4.85)	-2.13 (-4.19)		.94	
PRC	2.19			.07 (3.82)	-.12 (-1.10)	-.58 (-5.05)	.97	
East Europe	7.71			.38 (14.19)	.02 (.07)		.98	
OCP	.48			.09 (7.49)	.19 (1.65)		.94	

1/ t values in parentheses.2/ Logarithm of variable is used for developed regions.3/ Per capita total fiber consumption with respect to income per capita evaluated at the mean.4/ Total fiber use is the dependent variable.



Appendix table 3--Population, actual 1976 and projected 1985 and 1990

Region	1976	1985	1990
	<u>Million</u>		
United States	215.1	235.3	246.3
Foreign developed:	523.5	565.1	586.4
EC	259.1	271.4	277.6
OWE	85.7	90.5	93.4
Japan	112.8	123.0	126.8
OD	65.9	80.2	88.6
Developing:	1,978.1	2,539.6	2,894.9
Mexico	62.3	84.2	99.2
CAC	36.6	51.4	58.1
Brazil	109.2	140.5	160.5
OSA	109.6	136.5	153.0
Turkey	40.9	51.7	58.7
Egypt and Sudan	54.1	68.3	77.6
High	78.9	104.9	122.0
Low	45.3	61.0	71.6
OA	282.7	366.6	426.2
Pakistan	72.4	97.0	112.8
India	621.4	779.7	873.6
Far East	464.7	597.8	681.6
Central plan:	1,314.2	1,487.4	1,576.6
U.S.S.R.	256.6	281.0	293.9
PRC	840.9	959.5	1,018.5
East Europe	131.0	138.0	141.5
OCP	85.7	108.9	122.7
World	4,030.9	4,827.4	5,304.2

Appendix table 4--Per capita income, actual 1976 and projected 1985 and 1990

Region	Assumed real growth rate <u>1/</u>	1976	1985	1990
		<u>Dollars <u>2/</u></u>		
United States	3.1	4,749	5,716	6,366
Foreign developed:				
EC	3.5	2,246	2,928	3,409
OWE	4.5	2,468	3,476	4,205
Japan	5.4	758,373	1,113,498	1,405,640
OD	3.8	2,540	2,948	3,217
Developing:				
Mexico	6.0	16,893	21,123	24,032
CAC	5.7	413	490	571
Brazil	6.6	<u>3/</u> 9,364	13,462	16,220
OSA	5.2	<u>3/</u> 1,046	1,369	1,574
Turkey	6.5	13,847	19,373	23,334
Egypt and Sudan	4.9	<u>3/</u> 310	387	432
High	8.0	<u>3/</u> 343	541	682
Low	5.0	287	341	376
OA	4.5	<u>3/</u> 28	33	35
Pakistan	3.5	1,716	1,746	1,780
India	4.0	<u>3/</u> 1,172	1,355	1,471
Far East	5.9	204	266	311
Central plan <u>4/</u>				
U.S.S.R.				
PRC				
East Europe				
OCP				

1/ Growth rates are for total income not per capita.

2/ Personal consumption expenditures for developed and gross domestic product for developing, both in 1975 prices. Units are U.S. dollars in all regions except yen for Japan, pesos for Mexico, cruzeiros for Brazil, liras for Turkey, and rupees for Pakistan and India.

3/ 1975.

4/ Not projected.

Appendix table 5--Regression and accepted total fiber use, actual 1974 and projected 1980 and 1990

Region	:	:	Regression		:	Accepted	
	:	:			:		
	:	1974	:	:	:	:	:
	:	:	1985	1990	:	1985	1990
<hr/>							
	:	<u>1,000 metric tons</u>					
	:						
United States	:	<u>1</u> /5,499	7,388	8,423		7,388	8,423
Foreign developed:	:	7,497	10,132	11,469		9,825	11,064
EC	:	3,729	4,614	5,080		4,614	5,080
OWE	:	1,110	1,530	1,774		1,530	1,774
Japan	:	1,585	2,521	2,878		2,214	2,473
OD	:	1,072	1,467	1,737		1,467	1,737
Developing:	:	5,741	8,911	11,144		8,809	10,910
Mexico	:	288	483	620		483	620
CAC	:	148	247	327		247	327
Brazil	:	519	846	1,059		846	1,059
OSA	:	558	947	1,225		887	1,147
Turkey	:	313	553	717		478	587
Egypt and Sudan	:	221	285	333		335	403
High	:	451	1,063	1,537		892	1,220
Low	:	178	261	312		261	312
OA	:	468	667	818		667	818
Pakistan	:	382	464	549		533	632
India	:	1,301	1,571	1,718		1,571	1,718
Far East	:	914	1,531	1,924		1,531	1,924
Central plan:	:	7,887	11,214	12,780		11,022	12,556
U.S.S.R.	:	3,376	4,741	5,328		4,741	5,328
PRC	:	2,590	3,742	4,298		3,550	4,074
East Europe	:	1,773	2,425	2,754		2,425	2,754
OCP	:	148	306	400		306	400
World	:	26,226	37,645	43,816		37,044	42,953

1/ 1976 actual value.

Appendix table 6--Cotton's share in total fiber use, alternative projections for 1985 and 1990, trend only

Region	S-curve		Semi-log		Linear		Average share 1973-74
	1985	1990	1985	1990	1985	1990	
	<u>Percent</u>						
United States	18	14	27	25	5	-7	<u>1/</u> 30
Foreign developed:							37
EC	29	28	30	28	16	9	34
OWE	28	27	30	28	12	3	36
Japan	42	42	41	40	38	36	44
OD	37	36	37	36	25	19	40
Developing:							68
Mexico	21	12	51	49	28	18	48
CAC	26	17	54	52	33	24	51
Brazil	34	24	64	62	47	39	62
OSA	45	43	54	53	41	35	56
Turkey	60	59	64	63	54	49	65
Egypt and Sudan	<u>2/</u>	<u>2/</u>	<u>3/</u>	<u>3/</u>	<u>3/</u>	<u>3/</u>	90
High	40	39	41	39	30	24	45
Low	35	33	41	40	35	32	41
OA	<u>2/</u>	<u>2/</u>	78	77	74	73	74
Pakistan	<u>2/</u>	<u>2/</u>	86	86	81	78	89
India	<u>2/</u>	<u>2/</u>	86	86	82	80	89
Far East	48	46	54	52	35	25	57
Central plan:							64
U.S.S.R.	53	52	50	49	41	36	60
PRC	<u>2/</u>	<u>2/</u>	85	84	79	76	86
East Europe	33	32	33	32	21	15	37
OCP	<u>2/</u>	<u>2/</u>	80	81	82	84	76
World							50

1/ 1975-76 average for United States.

2/ Regions with shares falling at a very slow rate and with average shares at or above 0.75 for 1973-74 were not considered appropriate for the logistic curve.

3/ Trend coefficients were positive; results not reported.



Appendix table 7--Estimated price-dependent cotton share equations

Region	Sample period	Independent variables 1/			R <sup>2</sup>	Mixed price : OLS price : elasticity : elasticity	
		Constant	PCM	LT			
United States	1961-76	0.747 (29.77)	-0.090 (-4.32)	-0.118 (-7.37)	0.96	Not estimated	-0.17
Foreign developed:							
EC	1961-74	.520 ( <sup>1</sup> 54.91 <sup>1</sup> )	-.019 ( <sup>1</sup> -1.50 <sup>1</sup> )	-.064 ( <sup>1</sup> -9.66 <sup>1</sup> )	.94	-.03	-.02
OWE	1961-74	.594 ( <sup>1</sup> 38.24 <sup>1</sup> )	-.036 ( <sup>1</sup> -1.84 <sup>1</sup> )	-.080 ( <sup>1</sup> -7.46 <sup>1</sup> )	.91	-.05	-.03
Japan			<u>2/</u>				
OD	1961-74	.570 ( <sup>1</sup> 59.3 <sup>1</sup> )	-.038 ( <sup>1</sup> -2.98 <sup>1</sup> )	-.050 ( <sup>1</sup> -7.41 <sup>1</sup> )	.93	-.05	-.04
Developing:							
Mexico	1963-74	.861 ( <sup>1</sup> 52.47 <sup>1</sup> )	-.131 ( <sup>1</sup> -10.85 <sup>1</sup> )	-.078 ( <sup>1</sup> -7.49 <sup>1</sup> )	.99	-.13	-.13
CAC	1964-74	.803 ( <sup>1</sup> 61.87 <sup>1</sup> )	-.109 ( <sup>1</sup> -5.61 <sup>1</sup> )	-.058 ( <sup>1</sup> -5.13 <sup>1</sup> )	.95	-.11	-.10
Brazil	1967-74	.813 ( <sup>1</sup> 74.79 <sup>1</sup> )	-.083 ( <sup>1</sup> -4.20 <sup>1</sup> )	-.043 ( <sup>1</sup> -3.51 <sup>1</sup> )	.95	-.09	-.08
OSA	1966-74	.673 ( <sup>1</sup> 52.13 <sup>1</sup> )	-.024 ( <sup>1</sup> -1.09 <sup>1</sup> )	-.042 ( <sup>1</sup> -3.19 <sup>1</sup> )	.82	-.03	-.01
Turkey	1961-74	.772 ( <sup>1</sup> 118.60 <sup>1</sup> )	-.021 ( <sup>1</sup> -1.46 <sup>1</sup> )	3/ <sup>-</sup> -.007 ( <sup>1</sup> -5.09 <sup>1</sup> )	.91	-.02	-.01
Egypt and Sudan			<u>2/</u>				
High			<u>2/</u>				
Low	1961-74	.484 ( <sup>1</sup> 43.49 <sup>1</sup> )	-.034 ( <sup>1</sup> -1.70 <sup>1</sup> )	3/ <sup>-</sup> -.003 ( <sup>1</sup> -1.29 <sup>1</sup> )	.52	-.04	<u>2/</u>
OA			<u>4/</u>				
Pakistan			<u>2/</u>				
India			<u>2/</u>				
Far East	1965-74	.765 ( <sup>1</sup> 56.18 <sup>1</sup> )	-.031 ( <sup>1</sup> -1.41 <sup>1</sup> )	-.071 ( <sup>1</sup> 5.56 <sup>1</sup> )	.91	-.03	-.02
Central plan:	<u>5/</u>						
U.S.S.R.							
PRC							
East Europe							
OCP							

1/ t values in parentheses; asymptotic values in quotes for mixed estimation.

2/ Positive price coefficient; results not reported.

3/ Linear trend rather than logarithm of time trend used.

4/ Positive trend coefficient; results not reported.

5/ Not estimated.

Appendix table 8--Regression and accepted projections of cotton's share of total fiber use

Region	Regression		Accepted	
	1985	1990	1985	1990
	<u>Percent</u>			
United States	26	24	24	22
Foreign developed:				
EC	29	28	31	30
OWE	29	28	29	28
Japan	NA	NA	41	40
OD	36	35	34	33
Developing:				
Mexico	46	44	35	32
CAC	50	49	45	40
Brazil	59	58	50	44
OSA	52	51	47	44
Turkey	56	53	59	56
Egypt and Sudan	NA	NA	88	85
High	NA	NA	41	39
Low	38	36	38	36
OA	NA	NA	70	68
Pakistan	NA	NA	85	82
India	NA	NA	85	82
Far East	51	50	51	50
Central plan:				
U.S.S.R.	NA	NA	49	45
PRC	NA	NA	82	80
East Europe	NA	NA	33	32
OCP	NA	NA	73	71

NA = Not applicable.

Appendix table 9--Estimated mill consumption equations

Region	Independent variables <u>1/</u>		R <sup>2</sup>
	Intercept	MCW	
United States	13,968.3 (7.47)	-0.1055 (-3.08)	0.39
Foreign developed:			
EC	11,241.3 (20.56)	-.1203 (-12.02)	.91
OWE	405.1 (1.61)	.0238 (5.18)	.64
Japan	2,769.8 (5.45)	.0103 (1.10)	.08
OD	403.3 (2.40)	.0052 (1.68)	.16
Developing:			
Mexico	-169.5 (-2.33)	.0155 (11.66)	.90
CAC	-254.2 (-7.05)	.0073 (11.04)	.89
Brazil	-402.8 (-1.16)	.0342 (5.39)	.66
OSA	-176.5 (-1.30)	.0259 (10.41)	.88
Turkey	-1,651.7 (-4.95)	.0454 (7.44)	.79
Egypt and Sudan	-692.5 (-5.87)	.0295 (13.64)	.93
High	-455.7 (-4.49)	.0165 (8.86)	.84
Low	-392.8 (-7.00)	.0110 (10.74)	.88
OA	-2,283.8 (-10.85)	.0532 (13.80)	.93
Pakistan	-1,985.6 (-4.50)	.0680 (8.43)	.83
India	1,931.2 (4.23)	.0644 (7.75)	.80
Far East	-5,927.8 (-7.23)	.1557 (10.38)	.88
Central plan:			
U.S.S.R.	-730.5 (-1.60)	.1545 (18.53)	.96
PRC	-15,332.3 (-14.47)	.4443 (22.90)	.97
East Europe	878.7 (4.59)	.0395 (11.27)	.89
OCP	-495.0 (-7.04)	.0145 (11.23)	.89

1/ t values in parentheses.

Appendix table 10--Regression and accepted mill consumption, actual 1976 and projected 1985 and 1990

Region	1976	Regression		Accepted <u>1/</u>	
		1985	1990	1985	1990
<u>1,000 bales</u>					
United States	6,674	5,990	5,150	7,000	7,000
Foreign developed:					
EC	3,697	2,149	1,191	3,200	3,200
OWE	2,108	2,208	2,398	2,208	2,400
Japan	3,142	3,545	3,627	3,500	3,700
OD	574	794	835	794	835
Developing:					
Mexico	707	1,002	1,126	1,050	1,250
CAC	220	296	354	330	450
Brazil	1,975	2,183	2,455	2,600	3,000
OSA	1,438	1,783	1,989	2,050	2,475
Turkey	1,510	1,782	2,144	2,050	2,450
Egypt and Sudan	1,253	1,536	1,771	1,700	2,050
High	632	790	922	1,000	1,150
Low	283	440	528	440	600
OA	1,107	1,735	2,158	1,735	2,258
Pakistan	1,800	3,159	3,701	2,700	3,050
India	5,700	6,799	7,311	6,799	7,311
Far East	4,372	5,845	7,085	6,050	7,000
Central plan:					
U.S.S.R.	8,800	10,953	12,183	10,600	10,900
PRC	12,098	18,258	21,796	14,800	16,750
East Europe	3,371	3,867	4,182	4,200	4,500
OCP	377	598	713	660	800

1/ Accepted levels may differ slightly from projections in the tables on the market for cotton in foreign countries. This is because any residual, after establishing accepted projections, was distributed across regions.



Appendix table 11--Linear trend regression and accepted yield, actual average 1974-76 and projected 1985 and 1990

Region	1974-76 actual average	Regression		SEET 1/ 1990	Accepted		Source of accepted projections
		1985	1990		1985	1990	
		Kilograms per hectare					
United States	508	541	544	42	566	572	Judgement
Foreign developed:							
EC	671	958	1,079	44	0	0	NA
OWE	758	1,058	1,203	39	840	875	Judgement
Japan	NA	NA	NA	NA	0	0	NA
OD	512	773	843	139	698	720	Log trend
Developing:							
Mexico	284	337	359	12			Quadratic trend
CAC	852	1,035	1,132	40	930	946	Judgement
Brazil	800	926	983	57	885	900	Quadratic trend
OSA	241	283	296	25	291	311	Linear trend
Turkey	384	416	432	23	416	432	Judgement
Egypt and Sudan	750	1,080	1,229	62	860	940	Judgement
High	565	654	681	61	627	659	Judgement
Low	559	792	895	48	640	690	Judgement
OA	694	828	904	44	780	825	Linear trend
Pakistan	201	240	257	17	240	257	Linear trend
India	271	342	358	36	342	358	Linear trend
Far East	161	182	194	10	182	194	Linear trend
	240	313	344	28	313	344	Linear trend
Central plan:							
U.S.S.R.	640	823	911	30			Judgement
PRC	891	1,064	1,144	38	1,025	1,070	Judgement
East Europe	496	678	766	35	600	670	Log trend
OCP	351	428	466	38	362	371	Judgement
	162	212	212	20	180	180	
World	409	487	522	13			

1/ Standard error estimated from linear trend.

2/ Estimated trend coefficient is negative.

NA = Not applicable.

Appendix table 12--Estimated area response equations

Region	Independent variables <u>1/</u>			$R^2$	$E_S$ <u>2/</u>	$E_L$ <u>3/</u>
	Constant	PL	AL			
United States <u>4/</u>						
Foreign developed:						
EC <u>4/</u>						
OWE	-33.4	1.09 (.80)	0.875 (6.26)	0.74	0.20	1.60
Japan <u>4/</u>						
OD	-9.6	.44 (1.54)	.852 (7.96)	.89	.34	2.28
Developing:						
Mexico	-87.5	3.75 ( '1.77' )	.736 ( '10.85' )	.77	.38	1.42
CAC	29.7	2.42 (2.35)	.526 (3.12)	.66	.41	.87
Brazil <u>5/</u>	457.9	3.45 ( '1.36' )	.785 ( '4.05' )	.43	.09	.41
OSA	-50.8	10.79 (3.58)	.474 (2.06)	.69	.59	1.12
Turkey	413.3	4.26 (3.18)	.032 (.15)	.42	.36	.36
Egypt and Sudan	482.2	1.08 ( '1.75' )	.521 ( '2.43' )	.19	.06	.12
High	376.1	1.27 (1.86)	-.053 (-.24)	.20	.17	.17
Low	121.5	-.387 (-.51)	.660 (2.77)	.52	0	0
OA	736.2	.023 ( '0.01' )	.790 ( '8.91' )	.78	0	0
Pakistan	333.6	1.82 (.76)	.757 (6.29)	.76	.06	.25
India	1405.1	3.65 ( '1.76' )	.789 ( '4.12' )	.44	.03	.13
Far East	12.7	1.31 (1.99)	.761 (4.59)	.62	.21	.87
Central plan:						
U.S.S.R	214.7	1.76 (1.08)	.895 (10.85)	.92	.04	.35
PRC	2357.5	1.00 (.10)	.472 (2.14)	.26	0	0
Ear East	50.2	-.162 (-.98)	.495 (3.37)	.53	0	0
OCP	8.12	.013 (.07)	.709 (3.96)	.54	0	0

1/ t values in parentheses; asymptotic values in quotes for mixed estimation.

2/ Shortrun area response price elasticity evaluated at the mean; for price coefficient t values negative or near zero, this elasticity is taken as zero.

3/ Longrun area response price elasticity evaluated at the mean; for lagged acreage coefficient t values near zero, this elasticity is taken to be the same as  $E_S$ .

4/ Not estimated.

5/ The Brazilian equation has an additional variable, the logarithm of time trend, with coefficient estimated at -90.4 and asymptotic t value of 1.57.

Appendix table 13--Accepted base area and area response price elasticities, average 1972-77 and projected 1985 and 1990

Region	Accepted base area			Accepted elasticity
	1972-77 average	1985	1990	
	<u>1,000 hectares</u>			
United States	4,755	4,755	4,755	1.71
Foreign developed:	351	351	351	<u>1/</u>
EC	0	0	0	0
OWE	238	238	238	1.60
Japan	0	0	0	0
OD	112	112	112	2.28
Developing:	19,243	20,842	21,547	<u>1/</u>
Mexico	397	397	397	1.42
CAC	401	401	401	.87
Brazil	2,080	2,080	2,080	.41
OSA	1,238	1,700	1,850	1.12
Turkey	721	876	971	.36
Egypt and Sudan	1,067	1,300	1,500	.12
High	432	432	432	.17
Low	253	253	253	.10
OA	3,450	3,750	4,000	.10
Pakistan	1,898	1,965	2,000	.25
India	7,408	7,408	7,408	.13
Far East	355	355	355	.87
Central plan:	7,838	8,175	8,269	0
U.S.S.R	2,868	3,300	3,500	0
PRC	4,861	4,897	4,897	0
East Europe	75	72	72	0
OCP	27	27	27	0
World	32,186	34,123	34,922	<u>1/</u>

1/ Aggregated, implied longrun elasticities calculated at means of sample data, using accepted elasticities, are 1.65 for Foreign developed, 0.25 for Developing, and 0.37 for World.

Appendix table 14--Accepted income growth rates and base area projections,  
alternative II

Region	Income growth rate	Base area	
		1985	1990
		<u>1,000 hectares</u>	
United States	2.33	<u>1/4,755</u>	<u>1/4,755</u>
Foreign developed:			
EC	2.63	<u>1/0</u>	<u>1/0</u>
OWE	3.38	<u>1/351</u>	<u>1/351</u>
Japan	4.05	<u>1/0</u>	<u>1/0</u>
OD	2.85	<u>1/238</u>	<u>1/238</u>
Developing:			
Mexico	4.50	20,010	20,173
CAC	4.28	<u>1/401</u>	<u>1/401</u>
Brazil	4.95	<u>1/2,080</u>	<u>1/2,080</u>
OSA	3.90	1,600	1,700
Turkey	4.88	721	721
Egypt and Sudan	3.68	1,136	1,219
High	6.00	<u>1/432</u>	<u>1/432</u>
Low	3.75	<u>1/253</u>	<u>1/253</u>
OA	3.38	3,450	3,450
Pakistan	2.63	1,898	1,898
India	3.00	<u>1/7,408</u>	<u>1/7,408</u>
Far East	4.43	<u>1/355</u>	<u>1/355</u>
Central plan: <u>2/</u>		8,139	8,233
U.S.S.R.		3,300	3,300
PRC		4,861	4,861
East Europe		<u>1/72</u>	<u>1/72</u>
OCP		<u>1/27</u>	<u>1/27</u>
World		33,497	33,774

1/ Same as in Alternative I, see app. table 13.

2/ Income growth rates are not used for projecting central plan fiber use.



Appendix table 15--Regression and accepted mill consumption projections,  
alternative II

Region	Regression		Accepted <u>1/</u>	
	1985	1990	1985	1990
United States	6,661	6,479	6,600	6,600
Foreign developed:	8,900	9,031	9,134	9,201
EC	2,966	2,880	3,100	3,000
OWE	2,046	2,160	2,046	2,166
Japan	3,152	3,240	3,352	3,390
OD	736	751	736	751
Developing:	26,327	30,031	25,827	29,456
Mexico	1,205	1,395	950	1,075
CAC	306	405	306	405
Brazil	2,410	2,700	2,410	2,700
OSA	1,761	2,250	1,825	2,050
Turkey	2,131	2,565	1,725	2,050
Egypt and Sudan	1,575	1,845	1,475	1,770
High	927	1,035	927	1,035
Low	408	540	408	540
OA	1,608	2,032	1,508	1,913
Pakistan	2,502	2,745	2,502	2,745
India	6,303	6,579	6,303	6,579
Far East	5,191	5,940	5,580	6,550
Central plan:	28,047	29,658	28,176	29,842
U.S.S.R.	9,825	9,809	9,603	9,859
PRC	13,718	15,079	14,269	15,313
East Europe	3,893	4,050	3,693	3,950
OCP	611	720	611	720
World	69,937	75,199	69,937	75,199

1/ Accepted levels may differ slightly from projections in the tables on the market for cotton in foreign countries. Any residual, after establishing accepted projections, was distributed across regions.

Appendix table 16--Ratio of alternative II cotton use projections to alternative  
I total fiber use projections

Region	Base share <u>1/</u>	
	1985	1990
United States	23	20
Foreign developed:		
EC	31	30
EC	30	28
OWE	28	26
Japan	39	37
OD	31	29
Developing:		
Mexico	54	48
CAC	33	28
CAC	39	33
Brazil	47	39
OSA	42	37
Turkey	54	48
Egypt and Sudan	86	83
High	33	30
Low	37	35
OA	63	60
Pakistan	77	74
India	77	74
Far East	47	43
Central plan:		
U.S.S.R.	52	49
U.S.S.R.	44	41
PRC	78	72
East Europe	30	29
OCP	66	64
World	41	38

1/ Ratio of cotton-to-polyester price assumed to be 1.15:1.









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